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FROM

T. S. Gold

State of Connecticut.

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# TWENTY-FIRST ANNUAL REPORT

OF THE

# SECRETARY

OF THE

# CONNECTICUT BOARD OF AGRICULTURE.

1887.

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PRINTED BY ORDER OF THE LEGISLATURE.

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1887.

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T. S. Gold.

*To the Governor of the State of Connecticut:*

In accordance with the provisions of the Act creating a STATE BOARD OF AGRICULTURE, I have the honor to present the Report for 1887, Part I.

T. S. GOLD, *Secretary.*

WEST CORNWALL, November 1, 1887.

# STATE BOARD OF AGRICULTURE.

## 1887-8.

His Excellency PHINEAS C. LOUNSBURY, *ex officio.*

### APPOINTED BY THE GOVERNOR AND SENATE.

| | | TERM EXPIRES. |
|---|---|---|
| ALBERT DAY, . . . . . | Brooklyn, . . . . . . . . . | 1891. |
| J. P. BARSTOW, . . . . | Norwich, . . . . . . . . . | 1891. |
| J. W. ALSOP, . . . . . | Middletown, . . . . . . . . | 1889. |
| E. H. HYDE, . . . . . . | Stafford, . . . . . . . . . | 1889. |

### ELECTED BY THE AGRICULTURAL SOCIETIES.

| | | | |
|---|---|---|---|
| Hartford County, | J. H. Hale, | So. Glastonbury, | 1888. |
| New Haven County, | Dennis Fenn, | Milford, | 1889. |
| New London County, | James A. Bill, | Lyme, | 1889. |
| Fairfield County, | Edwin Hoyt, | New Canaan, | 1888. |
| Windham County, | H. Larrabee, | Windham, | 1888. |
| Litchfield County, | Wm. G. French, | Watertown, | 1888. |
| Middlesex County, | J. M. Hubbard, | Middletown, | 1889. |
| Tolland County, | Wm. D. Holman, | West Willington, | 1889. |

### ELECTED BY THE BOARD.

T. S. Gold, West Cornwall, *Secretary.*

## OFFICIAL LIST.

Governor Phineas C. Lounsbury, *President.*

| | | |
|---|---|---|
| Albert Day, | Brooklyn, | *Vice-President.* |
| T. S. Gold, | West Cornwall, | *Secretary.* |
| J. S. Kirkham, | Newington, | *Treasurer.* |
| Prof. B. F. Koons, | Mansfield, | *Entomologist.* |
| Dr. E. H. Jenkins, | New Haven, | *Botanist.* |
| Prof. S. W. Johnson, | New Haven, | *Chemist.* |
| P. M. Augur, | Middlefield, | *Pomologist.* |

E. H. Hyde, T. S. Gold, J. W. Alsop,

*Commissioners on Diseases of Domesticated Animals.*

Henry Larrabee, Wm. G. French, James A. Bill,

*Auditors.*

# REPORT.

*To the Governor of the State of Connecticut:*

The Twentieth Annual Meeting of the Connecticut Board of Agriculture was held at Hartford, Room 50, Capitol, January 26, 1887, at 10 A.M.

Hon. Albert Day, Vice-President, in the Chair.

Present: Messrs. Day, Hyde, Larrabee, French, Alsop, Hale, Bill, Hoyt, and Gold.

A committee on credentials was appointed by the Chair, Messrs. Larrabee, French, and Alsop, who reported as members-elect, Messrs. Dennis Fenn, Milford, New Haven County; James A. Bill, Lyme, New London County; J. M. Hubbard, Middletown, Middlesex County; and Wm. D. Holman, West Willington, Tolland County.

The report was accepted and adopted.

The report of the Secretary was read and accepted.

His Excellency Phineas C. Lounsbury, President of the Board, was present by special invitation, and took the Chair.

The report of the Commissioners on Diseases of Domesticated Animals was read and accepted, and ordered on file.

Messrs. Hoyt and Fenn were appointed Tellers, and the Board chose officers as follows:

Governor Phineas C. Lounsbury, *ex officio* President.
Hon. Albert Day, Brooklyn, Vice-President.
T. S. Gold, West Cornwall, Secretary.
Hon. J. S. Kirkham, Newington, Treasurer.
Prof. S. W. Johnson, New Haven, Chemist.
Dr. E. H. Jenkins, New Haven, Botanist.
Prof. B. F. Koons, Mansfield, Entomologist.
P. M. Augur, Middlefield, Pomologist.

E. H. Hyde, } Commissioners on Diseases of Domesticated
T. S. Gold, } Animals.
J. W. Alsop, }
Henry Larrabee, }
James A. Bill, } Auditors.
Wm. G. French, }

Hon. E. H. Hyde was elected Trustee of Storrs Agricultural School.

The report of the Treasurer was read and accepted.

On motion of Mr. Hubbard,

*Resolved,* That in the judgment of this Board the distribution of seeds or plants by the Bureau of Agriculture should be limited strictly to such varieties as are not in general use, and that these should be placed in the hands of those only who may be trusted to develop whatever value such varieties may possess.

*Resolved,* That the foregoing resolution be published and a copy be presented to our Senators and Representatives in Congress.

In answer to inquiries, the Secretary explained the custom and rules as to reports from members visiting fairs, and after discussion, on motion by Mr. Hubbard,

*Resolved,* That one session of the winter meeting be devoted to the reception of reports of visiting members at fairs. These reports to take the place of the reports to the Secretary now required.

*Resolved,* That the Commissioners on Diseases of Domesticated Animals be authorized to employ such veterinary assistance as they deem necessary.

*Resolved,* That the time, place, and subjects of the next winter meeting be left with the Vice-President and Secretary.

The Secretary reported invitations as received from Bridgeport and Hartford.

The assignment of members to visit fairs was left with the Vice-President and the Secretary.

On motion of Mr. Hoyt,

*Resolved,* That a committee of three be appointed for the purpose of obtaining from the General Assembly an increased appropriation for the Board.

Messrs. Hubbard, Larrabee, and Hale were appointed as this committee.

The Secretary presented matters pertaining to the annual report, and the questions of time, number of pages, of binding with it report of the Storrs Agricultural School, were placed in charge of the Secretary.

The Secretary explained work done as to stations for testing fruits and collecting statistics on roads.

The Board then adjourned *sine die.*

HARTFORD, Jan. 26, 1887.

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## AGRICULTURAL FAIRS IN CONNECTICUT, 1887,

### WITH DELEGATE VISITORS.

CONNECTICUT STATE, Meriden, Sept. 13–16. H. Larrabee.
NEW LONDON COUNTY, Norwich, Sept. 20–22. Wm. D. Holman.
FAIRFIELD COUNTY, Norwalk, Sept. 20–23. H. Larrabee.
WINDHAM COUNTY, Brooklyn, Sept. 20–22. J. H. Hale.
TOLLAND COUNTY, Rockville, Oct. 4–6. E. H. Hyde.
Berlin, Oct. 5. A. Day.
Bristol Park Co., Bristol, Sept. 26, Oct. 1. A. Day, W. G. French.
Chester, Oct. 6. J. W. Alsop.
Clinton, Oct. 11. J. A. Bill.
Danbury, Oct. 4–8. E. H. Hyde, E. Hoyt.
East Granby, Oct. 4.
Farmington Valley, Collinsville, Sept. 21, 22. P. M. Augur.
Guilford, Sept. 28. H. Larrabee.
Harwinton, Oct. 4.
Madison, Oct. 13. D. Fenn.
New Milford, Sept. 30, Oct. 1. E. H. Hyde.
Simsbury, Sept. 29, 30. J. S. Kirkham.
Southington, Sept. 27–29. E. Hoyt.

Stafford, Stafford Springs, Oct. 12, 13. J. A. Bill, J. P. Barstow.

Suffield, Oct. 5, 6. P. M. Augur.

Union (Monroe, etc.), Huntington, Sept. 28–30. D. Fenn.

Union (Somers, etc.), Ellington, Sept. 28. J. H. Hale.

Watertown, Sept. 20–22. J. S. Kirkham.

Westbrook, Oct. 4, 5. J. H. Hale.

Willimantic, Sept. 27–29. W. D. Holman.

Woodbridge and Bethany, Woodbridge, Sept. 28. D. Fenn.

Woodstock, South Woodstock, Sept. 14, 15. J. M. Hubbard.

Wolcott, Oct. 12. W. G. French.

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A special meeting of the Board was held at Room 50, Capitol, Wednesday, March 3d, at 11 A.M.

Hon. Albert Day, Chairman.

Present: Messrs. Day, Hale, Larrabee, Fenn, Barstow, Alsop, Hyde, Hoyt, Holman, Hubbard, and Gold.

The Secretary announced the object of the meeting, and Mr. Hubbard explained the two bills as presented by him (alternate) for legislative appropriation to the Board, and on motion of Dr. Alsop,

*Resolved*, That the bill appropriating one thousand dollars additional to the Board of Agriculture be approved by the Board.

Notice of the passage by the National Congress of the Hatch Bill for agricultural experiment stations was given by the Secretary, and a committee consisting of Messrs. Hale, Hubbard, and Gold was appointed to secure proper disposal of the fund by the General Assembly.

The Board then adjourned *sine die*.

T. S. GOLD, *Secretary*.

HARTFORD, March 3, 1887.

# REPORT OF COMMISSIONERS ON DISEASES OF DOMESTICATED ANIMALS.

Our flocks and herds have again enjoyed a year of general immunity from any serious contagious disease. The existence of pleuro-pneumonia in the State of New York in the county of Westchester, adjoining the Connecticut line, has required constant watchfulness on the part of your commissioners and of our agents. Every case of illness in neat stock has created alarm, and your commission have often been called upon from fear of this dreaded plague. But we are happy to report that not a single case has appeared in this State.

The order of quarantine against that part of the State of New York lying south of the north line of Putnam County, forbidding the introduction of all neat stock into this State from that section, was issued May 11, 1887, and has been strictly maintained.

BRONCHITIS. — Some cases of bronchial difficulty attended by slight coughing have occurred. The animals have been feverish and out of sorts, but have soon recovered.

TUBERCULOSIS in its protean forms is the worst disease that exists in our neat stock. Another year's experience confirms our previously expressed opinion as to the nature of this disease as in certain conditions, contagious among animals, and hereditary and communicable by the milk, to the human family, with fatal results. Profitless to the owners and dangerous to humanity, every animal affected with this disease should be killed as soon as the fact is established. The progress of the disease is so slow, and its forms so varied, that its contagious nature is not easily recognized, but this is well established by facts within our own knowledge as well as by the highest veterinary authority. Every owner of cattle cannot take alarm too soon where this disease is suspected. We have been called to numerous cases.

THE LUNG WORM in calves has again appeared in a few cases, just enough to emphasize the advice, to keep them away from infected fields or low grounds which are liable to be infected.

ANTHRAX, or black leg, has claimed its usual number of victims. The suddenness of the attack, the animals being in a thriving condition, always gives rise to the suspicion of poison, but the symptoms of the animal while sick, and the post-mortem appearances are very plain. In its ordinary form, one leg is affected, causing lameness, hence the name *black quarter*, but it may attack any part of the body and this indication be absent; moderate, even feed for calves and young cattle is the best preventive, while efforts at cure are useless. Saltpeter is a popular preventive, fed in small doses, when the stock are turned out in the spring or changed to rowen feed in autumn. A calf or yearling may be fed a small teaspoonful with salt; a larger animal a tablespoonful at the usual intervals of salting.

ABORTION IN COWS continues to some extent, and as connected with it, or one form of its development, young calves sometimes die soon after birth, without any apparent cause. Losses from this cause, though often very annoying and pecuniarily heavy, are rarely heralded by the owner. When we can explain the nature of the disease and provide a remedy, we shall be most happy to do so, but as yet we can only advise to seclude every animal that has aborted from the herd, and carefully remove and bury everything about the case, and disinfect the premises, stable, yard, or field. Much may be done in this way to check its ravages, or to restore a herd to a healthy condition.

TEXAN CATTLE DISEASE has occurred in a few cases in animals recently brought from the West, showing that our public lines of transportation are not free from infection by this plague, and that there is no safety in buying stock cattle during the warm season that have been transported by rail from unknown sources. Recovery is rare in case of attack. As native or northern stock when diseased, do not communicate the malady to other animals, its ravages here are confined to those that have been exposed to *through* Texans, or places infected by them; cold weather destroys the infection.

THE SCAB IN SHEEP has been introduced into the State by animals brought in for sale. Though rarely fatal, the miserable, worthless condition of an affected flock should be a warning to every one to avoid every chance for its entrance. The disease is not difficult of cure, by use of carbolic acid, thymo cresol, or other remedies, but the pens, yards, sheds, racks, everything that has been in contact with the suffering animal, retain the infection, to convey it to other animals or to the same ones again, as soon as the power of the remedial agent is spent. If any common sheep of unknown antecedents are to be brought on to any farm which has a choice flock for breeding purposes, they should be strictly quarantined till all chance of infection be past.

HOG CHOLERA has nearly disappeared from the State, and with proper care the infected districts may again keep swine, only be sure and get healthy stock. This advice must apply to the purchase of animals of every kind, especially in the present day, when the facilities of transportation are so increased, and animals may contract disease in transit even if healthy at place of original shipment.

E. H. HYDE,
T. S. GOLD,
J. W. ALSOP,
*Commissioners on Diseases of Domesticated Animals.*

HARTFORD, Nov. 1, 1887.

# PART II.

# FARMERS' CONVENTION.

The usual winter meeting of the board was held at Hartford, in Unity Hall, Pratt street, on December 14, 15, and 16, 1887. The sessions were all attended by exceptionally large audiences, who evidently took a lively and intelligent interest in the able and valuable papers which were read, as well as in the discussions which followed.

Vice President DAY, who presided at the opening session, called the meeting to order at 10 o'clock on Wednesday, December 14th, and said:

The hour has arrived at which this meeting was called, and in accordance with our usual custom it will be opened with prayer. Let us unite with Rev. Mr. TWICHELL in asking God's blessing upon us and the forgiveness of our sins.

### PRAYER BY THE REV. JOSEPH H. TWICHELL.

Almighty God, our Heavenly Father, — eternal, adorable, and holy Father of Mercies — Father of Jesus Christ our Lord — we praise, and bless, and worship Thee. Without Thee nothing is strong, nothing is holy, for Thou hast laid the foundations of the earth, and the heavens are the work of thy hands. By the breath of Thy Spirit there is a spirit in man, and the inspiration of the Almighty giveth him understanding. Let, therefore, the words of our mouths and the meditations of our hearts be acceptable in Thy sight, Oh Lord, our Strength and our Redeemer. Wilt thou give us humble and contrite hearts. We thank Thee for all Thy goodness to us; for the works of nature and the gifts of grace. Especially at this time would we praise Thee for Thy blessing upon the ground, for the ordinance of its increase, for rains from Heaven, and the fruitful seasons, filling our hearts with food and gladness. We beseech thee, O Lord, to bless Thy servants who have come together here to consult upon the interests of their great and ancient calling. Give them the wisdom they need, that by their discussions and by a comparison of their thoughts and observations they may learn what is Thy will. Reveal unto them Thy thoughts, who art the creator and ordainer of all things that are of earth. We beseech Thee to bless our country and prosper it in every noble and worthy interest, and give us peace in our time. May religion, righteousness, truth, justice, knowledge, and freedom abound everywhere within our borders. May we keep alive in us the faith and virtues of those who have passed before. May we be not unworthy of the sacrifices of the past and the hopes of the future. May Thy name be glorified and Thy kingdom rule over us from sea to sea. And do thou hasten, O Lord, the day of Thy glory, of the coming of Christ, and the deliverance of all the nations of the earth. And to Father, Son, and Spirit be praise evermore. Amen.

The CHAIRMAN. I introduce to you the Hon. WILLIAM E. SIMONDS.

## ADDRESS OF WELCOME.

### BY HON. WM. EDGAR SIMONDS.

*Ladies and Gentlemen,* — You meet in this place by virtue of an invitation from The Hartford Horticultural Society, supplemented by the generosity of some Hartford gentlemen who have so much desired your presence that they have voluntarily supplied the necessary means. That invitation includes not only the Connecticut Board of Agriculture, but all other associations and individuals who take an interest in the affairs of farmers. I am not a member of The Hartford Horticultural Society, nor am I one of those gentlemen who have supplied the neceesary means, but in their name, and at their request, I extend to you all a cordial and heartfelt welcome, expressing the fervent hope that the occasion may be one of great usefulness, of equally great enjoyment, and one long to be remembered.

It is a pleasure to speak this opening word to a convention representing the farmers of Connecticut. It is a pleasure to think of like conventions held in many different States of the Union. There are larger conventions and noisier conventions for other purposes, conventions which fill a greater space in the public eye and make more sound and fury in the public ear, but there are none which represent interests so important as those represented by the farmers' conventions and none whose objects are so unselfish and so in harmony with the general good of the whole community.

The census of 1880 gave as the total of all persons engaged in various occupations seventeen millions and a quarter, and as the total of all persons engaged in agriculture over seven and a half millions, while manufactures and mining together employed less than four millions. By this census of 1880 the estimated value of all the property, real and personal, in the United States, was forty-three thousand millions of dollars, while the value of the farms — I think not including stock and tools — was over ten thousand millions; meanwhile the capital invested in manufacturing was only twenty-seven hundred and ninety millions. The total presidential vote of 1880 was less than nine and a quarter millions; as the seven and a half millions of persons engaged in agriculture were almost all adult males and voters they must have cast more than one-half the entire presidential vote.

These figures show that the agricultural industry of the country is of vastly more importance than any other; that it employs more than double the number of persons employed by any other industry; that it uses more than double the capital used by any other industry, and that it possesses the major part of the political power of the whole body politic. If the farmers had anything like the solidarity and organization of some other classes they would never need to *ask* anything of Congress or the State legislatures; they would be able to *take* it without the asking. Will the farmers of Connecticut remember that, when our next legislature comes to act on an appropriation for the main building for the Storrs Agricultural School, the handsome and efficient laboratory for which is soon to be completed?

It was the farmer who leveled the primeval forests and subdued the soil; it was mainly farmers who stood in embattled host at Bunker Hill; it was the farmer, Israel Putnam, who left his plow in the furrow and hastened to command at Bunker Hill; it was the farmer, George Washington, who was the first President and the first commander of the armies of the republic; it was mainly farmers who fought the battles of the Revolution; it was farmers who led the van of civilization all the way from the Atlantic to the Pacific, planting each frontier line with school-houses and churches, and it is farmers who have been the great conservative force, the balance-wheel of the political machinery of the republic.

Nevertheless, these farmers' conventions talk of none of these things; they do not even think of them. You will listen to this prelude because you must, because it is on the programme; then will begin the real work of the convention, and you will spend all your time in earnest study and discussion of the practical and scientific questions involved in agriculture. The local newspapers, with kindly tolerance, will give reports of what takes place here, and then all interest in the matter will end for the general public, while if this were a political convention, sitting to name a candidate to adorn, or fail to adorn, the gubernatorial chair, this hall would not hold a fraction of those who would desire to hear; all the newspapers would give full reports, and your doings would be discussed all over the State.

We have some curious relics of barbarism in our civilization. We laud to the skies our great warriors, men who prove themselves supremely expert in killing their fellowmen and in suddenly destroying the results of years of peaceful industry, and we let the real builders of our prosperity go unhonored and unsung. The compound marine engine is doing more for the material prosperity of the peoples of the earth than almost any other one thing, but not one man in a thousand knows the names of its inventors and improvers. Farmers, inventors, and mechanics are in some sort like the creatures that build the coral islands in the ocean; unseen they delve (or, at least, exist), to raise the coral structure to the surface of the sea and in death they give their bodies to the same end; in time the reef appears above the water and in yet more of time it comes to be an island with grass and trees, but it gives no surface sign of the builders without whom it would not have been. Much in such silent and modest fashion do the farmers, the inventors, and the mechanics build the fabric of our material prosperity, leaving on the surface no sign of their individual presence. The weeds and grass get noticed.

I have said that the farmers are the balance-wheel of the political machinery of the republic. I look to see them perform a very grave and important function, in this regard, in the future. The labor agitation has come to stay; its methods will be peaceful but it will be persistent. Aside from a few students and thinkers the great mass of dwellers in towns and cities are likely to be annoyed by the presence of the agitation and likely to be unwilling to turn from the fierce competitions of business long enough to thoroughly understand the drift of the agitation. In the friction of the political machinery which will result our millions of cool headed farmers will prove a steadying force of inestimable value.

Let me point out to you, if you have not already noticed it, that the tendencies of modern business life are strongly toward combination. Workingmen combine in trades-unions, federations of trades, and as knights of labor; employers combine to resist the combinations of the workingmen; the railroads, which set the first example in this direction, are wonderful specimens of combination; and to cap the climax, a nondescript unlawfulness now makes its appearance in the shape of the so-called "trusts," such as the Standard Oil Trust, the sugar trust, the straw-board trust, the wall-paper trust, and so on.

These combinations may not be right and proper things from a purely ethical point of view, but, human nature being what it is, they — the "trusts" excepted — are probably a necessary step in the process of development toward higher and better things. Meanwhile, can the agricultural industry, representing as it does more persons and more property than any other, afford to be without systematic and thorough organization? Clearly not. The Grange seems to be a satisfactory form of organization. Then why should not every farmer become and remain an earnest member of it? It can be the efficient agent of universal co-operation among you in both buying and selling. It can be your efficient agent in procuring proper legislation and in resisting wrongful.

It is high time that the Grange, and the farmers generally undertook a careful study of the workings of the tariff, so as to intelligently determine for themselves whether their interests are best served by protection, by free trade, or by some middle ground. Farmers have a great interest at stake here; they must patiently study to find where that interest lies; finding out their weight it should be thrown in the right direction; that weight thrown solidly would determine the matter.

This leads me to remark that the internal revenue tax on tobacco is almost sure to be abolished at this session of Congress. As the tobacco growers of the Connecticut valley desire this they will accept these goods the gods provide and be thankful. There is, however, one curious and interesting reason why this will be done. The managers of the whisky distilling industry are rich, strong, and well organized. The liquor manufacture has reached that stage when no small distiller can live and pay the internal revenue tax; to make the business profitable one needs a large plant, large capital, and, probably, a means of evading the revenue on a considerable part of the product. Hence, by reason of the internal revenue tax on liquor-making the larger distillers are enabled to freeze out the small ones, and this they do most effectually.

The large distillers, probably, have their own detectives in every distilling locality; this is, probably, one reason why the moonshiners of the South are pursued so rigorously and why mere technical violations of the law by distillers of cider brandy in New England are brought to the notice of the officers of the law so promptly. To take the internal revenue tax off whisky will destroy this monopoly. But it is agreed that the government revenue must be reduced somewhere and at some point. Therefore, the large distillers have determined that the internal revenue tax shall be taken off tobacco in order that it may be left on whisky, and it will be done. Both protection and free trade will be left to take care of themselves meanwhile.

Gentlemen, the real object for which I was sent here was to bid you welcome. You are, therefore, at liberty to forget every word I have said except those that extend to you a greeting that is intended to be warm and hospitable. If you forget that, or if I shall fail to impress you with the sincere character of the welcome, that is extended to you all, then I shall misrepresent the men who bade me come.

The CHAIRMAN. *Ladies and Gentlemen:* I shall now call upon one of the veteran farmers of Connecticut, Mr. Secretary GOLD. I have the pleasure of presenting to you Mr. T. S. GOLD, of West Cornwall.

Response by Secretary GOLD.

### RESPONSE BY THE SECRETARY.

I thank you, sir, in behalf of the Board of Agriculture, and of the farmers here assembled, for your fitting words of welcome and encouragement, and at the same time I would call to remembrance with grateful feelings what you have done in other positions of trust for the cause of agriculture. Let us now turn our attention to the objects for which we are here in convention. What is to be gained by this and similar assemblies throughout our country?

We do not meet simply as farmers to discuss questions of practical agriculture — when and how to plow — what fertilizers to be used and to what crops are manures most profitably applied, methods, and materials for feeding, dairy practice, fruits — when, how, and what kinds to plant, diseases of plants and animals, our natural friends and foes, beasts and birds, the largest of which we have subdued or exterminated, and against the smaller we are waging an indiscriminate warfare, as well as against useful and noxious insects. These are all legitimate subjects for our study and discussion, but we have still other objects in view. Our executive officers of the State, our law makers, members of the General Assembly, the officers and members of our agricultural societies, farmers' clubs, and granges, citizens of every class and profession, with their wives and daughters, are all invited to unite with us, and we rejoice to see such a gathering as this to-day in the capital city of the State, — not for the purpose of making laws, not for discussing questions of party politics, or even for the purpose of advancing the interests of our special calling, as indicated by the name "Board of Agriculture," to the injury of any other, but with purposes and aims higher and nobler than these — of discussing, free from party influence, those great questions which pertain to the material development of the State and Nation, to gather up and diffuse that knowledge which must be the basis of all intelligent legislation, thus exercising a power behind the throne which our mothers and wives in no unequal degree share with us. We said "material development," but we desire reverently to acknowledge that only "Righteousness exalteth a nation," that no material advancement should be sought that is not in harmony with the Divine law of love, so that while we cherish and guard our own interests and rights as individuals, as a class, as a nation, it must not be done at the expense of others, but acknowledging the brotherhood of mankind, recognizing the fact that individually humanity is weak, but united, controlling all the powers of nature thus made subservient to the use of man, by the pressure of a finger, the stroke of a pen, by the exercise of mental or physical forces less than the mother exerts in training her child, the highways of nations are ruled and peace or war reign throughout the earth.

But to come to the work before us. The needs of the hour demand our attention to various subjects, as set forth in our program.

Tuberculosis, a most insidious and fatal disease, disguised in Protean forms, threatens our neat stock, and through our meat and milk supply becomes dangerous to humanity. The knowledge by which its presence may be detected and its spread prevented, should certainly be in the possession of all stock owners, as we must rely mainly upon them to protect us from its baleful consequences.

Dairy products plainly concern every family in the land, but just now the dairy, more than ever before, comes to the front in agriculture. Greater changes are being wrought here than in any other department of husbandry.

Gilt edged butter designated as "rosy" and "nutty" and "golden," bringing a dollar a pound and cheap at that, as an article of healthful luxury, compared with the soft, greasy, streaked, salvy, odorous compound that so often went begging for ten cents in shelf goods at the country store, has awakened farmers to the situation, and the dollar and ten cent sort are now scarce, but instead of the two extremes, creamery butter and private dairies, meet the demands of the consumer, and the farmer realizes two or three times his old price, not by any corner in the market, but because the product has an increased intrinsic value, and the demand has grown because met by a more abundant and reliable supply, while the farmer's household has been relieved from a self-assumed drudgery, because the profits were too small to warrant the employment of outside assistance ; but the end is not yet, for we deal with the most complex and most wonderful of all nature's provisions, still we are sure we are on the royal highway.

Scientists and practical men are in harmony as to the value and necessity of testing by experimental work in public institutions, questions of fertilization, culture, fodders, and feeding, seeds and fruits. The recent act of Congress, called the Hatch bill, appropriating from the national treasury fifteen thousand dollars annually to each State for maintaining experiment stations, makes this a very opportune time to discuss the subject, to study its possibilities, to learn how and to what extent scientific investigation can aid agriculture.

Not very long ago the farmer derived about all his family supplies from his own farm, selling comparatively but little. Transportation with him was a small affair. His salt and plaster, nails, and imported groceries, were bought and paid for by the sale of a little grain, butter, and cheese, pork and beef, while the annual sale of a pair of oxen paid the hired man. A few visits to the market-town, or mill and a weekly ride to meeting, mostly covered his use of the roads. Transportation formed but a small element in the cost of his living or sale of his products. More than half the cost to the consumer is now due to transportation. Now the iron rail brings the States in closer connection than once were townships.

Not only do the fresh fruits of the tropics grace the farmer's board ; his bread is grown a thousand miles away, while his milk, a most perishable product, is served at city tables, hundreds of miles distant, the most tender fruits and vegetables find consumers in far-off States, or across the ocean, and the farmer of New England, following the trend of events, perhaps buys his butter and cheese, his beef and pork, his lamb and mutton, when he has any, and the bulk of his grain feed for his stock, and alas, his fuel and lighting materials, all having paid transportation, perhaps for a thousand miles, so that the farmers have a direct interest in the railroads as well as in the common roads, with which they have so much to do, not only in the construction and repair, but in paying taxes for their maintenance and in their daily use.

A farm located two miles from a railroad station, not an unfair average, and shipping two thousand cans of milk a year, of forty quarts, transports in milk alone one hundred tons annually. Add twenty-five tons for fruit, vegetables, etc., sold. The return milk cans will be twenty tons ; add grain, fertilizers, coal, lumber, and family supplies, and you make nearly an equal amount of return freight, or about two hundred and fifty tons transported two miles for not an exceptional farm in Connecticut. Take into account the further use of the roads, for social intercourse, for schools and churches — is not the farmer interested that the roads should be of the easiest grade and in the best condition ?

This question is a vital one to all the rural districts of Connecticut, and wrapped up in it we find one reason for the neglected farms, the deserted hearths of New England. We charge these changes to local and railroad transportation as prime factors in this much deplored condition of affairs.

The session given to reports of delegate visitors to fairs will furnish an opportunity for discussion upon the condition and management of our agricultural fairs. Sweeping denunciation and unfounded charges may do much harm, but friendly criticism ought to result in much good. The hands of the managers will be supported and their labors in the cause of agriculture made more efficient by the candid advice of their constituents, who are their masters.

"The Possibilities of Connecticut Agriculture" and "Thoughts Agricultural-wise and Otherwise," fitly come in to supplement our work.

The Question Box is now open to receive questions upon practical agriculture, and we trust that every one will be free to use it, and ready to serve those who may apply to it for aid.

Our fruit exhibit is an object lesson that needs no invitation from me. It will attract your attention in all spare moments during the convention.

This is the twenty-first Farmers' Convention called by the Board of Agriculture. The second, January 14, 1868, was also held in Hartford, and I confess we were a little lonesome in those days. There were more empty benches than now — in the Superior court room, where we met, but we enjoyed the hopefulness of early youth and now, standing as a young man, having attained his majority and entered upon all privileges and duties of citizenship, we meet, not without some diffidence and self-rebuke that we have done no more for Connecticut Agriculture, but still with the feeling that the Board of Agriculture has earned its right to exist, and that the more widely its works are known, the greater will be its power for good to the citizens of Connecticut.

I cannot close without giving you a sentiment from Father Hyacinthe, expressing in happy phrases the union between agriculture, manufactures, and commerce, in an address before the Peace League in Paris in 1869.

"The justice which man owes the earth is agriculture, industry, commerce. Agriculture holds the foremost place. The earth lies in a lethargic slumber till it is roused by the stout arm of the laborer. It imbibes the sweat of man's brow, and becomes intoxicated with those bitter and sacred drops; it becomes disgusted with its native barbarism and yields itself actively and gladly to the transforming and fertilizing culture. So the earth, established in justice and truth, becomes the foster mother of multitudes, opening her generous breast to men of every nation, and pouring out to them those great streams of physical life, without which all moral life itself would speedily die away. The farmer, with worthy pride, turns over to the artisan the product of his labor and says: 'Brother, complete my work and begin your own! pursue the great toil prescribed by God for man.' And the artisan takes the fruits of agriculture, summons from every quarter the hidden or refractory powers of nature, subdues the refractory, brings to light the hidden, and in his turn creates those wonders which are the last utterance of man and of a matter in the sphere of the useful, as the fine arts are their last utterance in the sphere of the beautiful, and when farmer and artisan have done their work, then commerce lifts her broad wings, her sails fill, her engines hiss and throb, her ships plow the sea, her fiery chariots traverse the land, the arteries of nations open in every direction that the blood of a common civilization, the vivifying sap of the same moral ideas and the same material products may permeate all mankind. And the word of St. Paul is fulfilled, which was not made known before the coming of Christianity, that supreme inspirer of great things: '*Gentes esse cohæredes*,' 'that the nations should be fellow heirs.'"

The CHAIRMAN. The natural history of tuberculosis is a subject of intense interest to every farmer and to every inhabitant of the United States. Its cause, its cure, and the possible means of exterminating it, are questions in which every inhabitant of the United States is deeply interested. I have the pleasure of introducing to you a gentleman who has, perhaps, given this disease as much thought and as much practical attention as any man in New England, and who, with the characteristic earnestness which he puts into every work in which he is engaged, is as able to deal with it as any man who could be presented before you. You have doubtless already anticipated me. Ladies and gentlemen, I now present to you Dr. CRESSY.

# NATURAL HISTORY OF TUBERCULOSIS.

By Noah Cressy, M.D., V.S., Ph.D.

In entering upon the discussion of this important theme with the new light which recent biological investigations have thrown upon the subject, I deem it opportune to recapitulate, by way of an introduction, some of the leading historic facts, as set forth in my previous writings,* concerning the contagious nature of this wide-spread and destructive malady. By so doing we shall be better prepared to inquire into the natural history of this disease and to explain the real mode of transmission, which, for ages, has baffled the scientific world. But the faithful and extensive researches of Dr. Robert Koch of Germany, who, in 1882, discovered the method of staining this long sought-for germ, solved the mystery, and enables us to identify this special bacillus in all forms of tubercular affections.

Dr. Morgagni, a celebrated Italian physician, more than a century ago, claimed that the virulent matter contained in the expired air of a consumptive patient was very infectious, and liable to transmit the malady by inhalation. This original and prophetic declaration was based on a series of observations, and, though not generally received by the profession as valid, yet the truth of his conclusions has recently been demonstrated by an ingenious experiment by Dr. Tappeiner of Meran, who caused animals to inhale fine tubercular matter which had been evaporated in a room, by a steam atomizer. About ninety per cent. of all the puppies thus confined from twenty-five to forty days, showed well-marked miliary tubercles in both lungs, on post-mortem examination, thus demonstrating in a very conclusive manner that these bacillian germs are borne by the breath and may become exceedingly dangerous.

Another trustworthy experiment on the contagiousness of this disease was performed in 1865 by Dr. Villemin of the Val-de-

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*See the author's address on "Diseased Meat and Its Consequences upon Our Health and Happiness," in Connecticut Agricultural Report for 1879, page 804. The same was reprinted in *The Archives of Comparative Medicine and Surgery*, New York, in Vol. I, No. 4, October, 1880, and in Vol. II, No. 1, January, 1881.

Grace Hospital, Paris, who inoculated a series of rabbits and guinea-pigs with tubercules from the human lung. Though this matter was inserted in various parts of their bodies, yet the effect was quite general and of a serious character, as the various examinations after death revealed. He also experimented with matter from a cow and with similar results; and by these carefully conducted researches Villemin has shown that such artificial tubercle has the same virulent property for inoculation as when the disease arises spontaneously,* which is a proof in itself of a specific microbian virus, in accordance with the claims of our new pathology.

Additional evidence of the infectious nature of the malady was afforded by the well-designed experiments of Prof. Chauveau of the Lyons Veterinary school in 1868, who found that rich virulent matter would infect an animal through the digestive organs quite as readily as in any other way. He accordingly fed three calves with both the hard and soft varieties of tubercle from a bovine lung, and in a few weeks marked symptoms of this infection appeared, with loss of appetite, rough, staring coats, occasional fits of coughing, emaciation, and diarrhea. An examination of the various organs revealed characteristic lesions of the transmitted malady, and the fact that animals can contract this disease through the agency of the feed, should give us new apprehensions in the use of meat and milk from infected animals, both of which under certain conditions, as I have elsewhere shown, may contain the morbid germs in question.†

The spread of this disease by contaminated stalls has afforded several rich opportunities for the study of its clinical history and pathology; and Dr. Grad's observations at Leinheim were not only valuable in this direction, but paved the way for a series of microscopic investigations which culminated in the discovery of this bacillian germ. The thriving young cow that he chose for this experiment was well bred and from healthy progenitors, but from the time she was placed in this infected stall, where five animals had previously died from consumption, no change occurred until after calving, when a cough appeared, and gradually increased in frequency, with emaciation, and all the attendant symptoms of this malignant malady.

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* See Fleming's Essay, in *Veterinarian*, London, for January, 1875.

† Author's address before the Maine Board of Agriculture, on "Transmission of Bovine Tuberculosis," in Secretary Gilbert's Report for 1886.

This was a pathological demonstration, and the true explanation is set forth in Chauveau's ingestion experiment, before alluded to; for the dried sputa and other expectorations on boards of the manger, was the only source by which the germs of this disease could be conveyed to the animal in question. Dr. Klebs, who made the first investigation in this line, and Schueller, contributed a series of experiments on feeding tuberculous material, about ten years ago, that threw new light on the subject, and thereby forced the opinion on our profession that tuberculosis was a specific disease and propagated by living germs.

## MYCOLOGY OF INFECTION.

The real nature of contagia has been the Gordian knot of pathology for many centuries. The classic opinion of Hippocrates, Aristotle, and Galen, that the infectious quality of disease was a subtle entity, has been generally endorsed by the ages of medical lore. Both the early Fathers and subsequent philosophers of the Healing Art, searched in vain for the essential principle involved in the transmission of a contagious malady; and the historic acumen of our profession has attributed this pathogenetic agency, until within a score of years, to the inherent qualities of imponderable germs.

The sterling achievements in mycological pathology,* which the last decade has wrought, has revolutionized in a great measure, all previous conceptions as to the specific nature of a virus, and it has now been demonstrated by the concurrent testimony of many expert observers, that the disease-bearing germs of anthrax, tuberculosis, and other contagious maladies are tiny parasitic organisms that belong to the marvelous world of microscopic plant life.

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* See Comparative Morphology and Biology of the Fungi, Mycetozoa, and Bacteria, by Prof. A. De Bary, translated by Henry E. F. Garnsey, M.A., and revised by I. B. Balfour, M.A., M.D., F.R.S. Imp. 8vo, London, 1887. Also, De Bary's Lectures on Bacteria, translated and revised by the same authors. Second edition, 12mo, London, 1887. A Synopsis of the Bacteria and Yeast Fungi and Allied Species, by Prof. W. B. Grove, B.A., 12 mo, London, 1884.

The results of these researches, therefore, have not only awakened new zeal among scientific men, both at home and abroad, but have necessitated the recognition of a biological factor, in study of the causation of many forms of disease; yet long before the *contagium vivum* had been discovered, pathologists, believing that the morbific principle affecting the system, in a large group of epidemic and sporadic form of disease, closely resembled the action of a ferment, proposed the zymotic theory, which, though vague in its chemico-physiological significance, has been almost universally accepted by modern authors. The analogy seemed very striking in many respects, even when first enunciated; but the discovery that the active agent of fermentation was a minute vegetable organism,* which grew and multiplied at the expense of the saccharine liquid, virtually paved the way for the germ theory of disease.

The true part played by the vegetable germ in the causation of disease is well illustrated by the changes in the eye of a rabbit as noted after an inoculation of the anterior chamber with tubercle or a bacilliferous liquid. The first change observed is the formation of a scar and the encapsulation of all foreign bodies by granulation tissue. About the third day there will be seen an increase of bacilli, which in the next twenty-four hours will multiply so rapidly that they will extend into the sclerotic coat and the iris. On the fifth day these germs, according to Baumgarten, can be detected in these membranes, partly free in the intercellular substance or contained in fixed cells, but in neither case giving rise to any morbid change. Very soon, in connection with masses of bacilli in the iris and cornea, a few cells of an epithelian character appear, some being giant-cells and others lymphoid, which Virchow claimed were characteristic of miliary tubercle. Thus the different stages in the production of this disease are here well defined. First there is a multiplication of these bacillian germs and their extension to the neighboring parts, where, if present only in small numbers, they appear not to cause any disturbance, but if in masses they excite an inflammatory action which results in exudation and the formation of giant-cells, and later on the disorganization of the whole tissue. In fact, we can hardly imagine, says Dr. Williams,* a more complete proof of the action of bacilli in a pathological point of view.

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* Pathological Mycology, an Enquiry into the Etiology of Infective Diseases, by G. Sims Woodhead, F.R.C.P., and Arthur W. Hare, M.B., C.M. London, 1885. Microbes, Ferments and Moulds, by E. L. Trouissart, Vol. LVII of the International Scientific Series.

In fact it is now conceded that all infectious maladies have a continuous existence, like the succession of organized beings, and that they arise from the diffusion of these living germs, no competent pathologist will deny.† Throughout the vegetable world each seed produces its kind, and the acorn never contains the germ of any other tree but the sturdy oak; so in accordance with our theory, as recent investigation has shown, each contagious disease has its own specific virus, which can induce no other malady than the one from which it was derived. Thus every disease germ must come from pre-existing ones, and consequently the spontaneous origin of any transmissible malady is quite as untenable in the present state of science, as the equivocal generation of plants and animals.

The tubercle-bacillus varies in length from $\frac{1}{8000}$ to $\frac{1}{12000}$ of an inch, and their usual breadth is about one-fifth of this dimension, but these bacilli are also quite variable in their transverse diameter, and some, which are undoubtedly the older ones, are twice as thick as others and invariably beaded, ready to divide, by the natural process of bissiparous generation, which is characteristic of this whole group of rhizomycetes. Bacilli are not always straight but some are more or less curved, forming a segment of an arc, and several of these rods may be seen lying side by side in different stages of segmentation. Thus in this beaded appearance there are certain dark spots which mycologists now believe to be spores, and as each of these forms a young bacillus the rate of multiplication is enormous.

Dr. Veragut's inhalation experiments have thrown additional light on the pathogenetic influences of the vegetable germs in the animal economy; for he found that the bacilli entered the alveolar epithelium, causing it to swell and desquemate. This epithelial inflammation was accompanied with hyperæmia of the capillaries and exudation of lymph into the infected cavities. The walls of these cells were then destroyed and masses of bacilli thus let loose into the exudation; but around these masses was developed a connective tissue capsule which thus isolated the caseous material. Necrosis then commences in the center of the tissue and the bacilli disappear. Single germs passed through the encapsulating membrane and entered the lymphatics, producing secondary growths, which appeared to be miliary tubercle with typical giant cells, containing bacilli. In time all these structures caseated and were more or less infiltrated with a chalky deposit which no longer rendered it a suitable habitat for these bacillian germs.

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* Pulmonary Consumption, its Etiology, Pathology, and Treatment. Second edition, enlarged, and re-written, with six colored plates. London and Philadelphia, 1887.

† A text-book of Pathological Anatomy and Pathogenesis, by Prof. Ernst Ziegler, translated by Donald Macalister, M.A., M.B. Macmillan & Co., London and New York, 1883. Introduction to Pathology and Morbid Anatomy, by T. Henry Green, M.D. Sixth edition, London, 1884.

The minute distribution of tubercle in the liver, according to the observations of Ribbert, afford a striking illustration of the action of bacilli in the causation of this malignant malady. The small nodules under the microscope revealed the following interesting structure. First, a central caseous mass; second, an outer layer of tubercular cells; third, a bacilliferous zone; and lastly, an external margin of inflammatory tissue. He claims that with the growth of the tubercle the bacilliferous zone continued to extend its area, and that caseation occurred not from the direct action of these germs but from cutting off the blood supply, through their pressure on the capillary vessels. The connective tissue in the walls of the veins were thickly invaded by bacilli which occurred in irregular shaped masses in encroaching upon the lining membrane of the vessels; for the bulging in this inner coat produced the appearance of minute tubercles, and by contracting the calibre of the small arteries or veins obstruction to the circulation was unavoidable. In fact a like invasion of blood-vessels in the human lung would explain early hæmoptysis; for such vessels weakened by the ingress of these organisms would yield before the pressure of this vital stream and thus give rise to hemorrhage.

There is another feature that should not be lost sight of in studying the *modus operandi* of the action of these bacilli, for they are invariably found in freshly formed tubercle, but in the gray and older miliary nodules they are often absent. In caseous masses the distribution is quite irregular, but where this rupturing is uniform and firm few bacilli are found. Wherever this process is going on, and microscopical cavities are present, bacilli are often found in great numbers, but in the fibroid type of this disease they are entirely absent. These germs are found in the greatest abundance on the walls of cavities in process of formation; they therefore abound in cavities formed in infiltrated tissue, as in caseous pneumonia and acute phthisis, and are scanty where the walls are fibrous, as is so often seen in the chronic fibroid forms. In fact this elemental tissue seems to serve as a barrier to the growth and multiplication of these organisms, and often in large tracts of the lungs which have undergone fibroid degeneration not a single bacillus could be detected by the most careful manipulation with the miscroscope.

The bacilli in the giant-cell usually appear on the side, as represented in Fig. 3, but with an increase they invade the tissue, separate the nuclei and thereby break down the walls, and in a short time the site is occupied by a circle of these destructive germs, and many such groups have been seen in microscopic lung sections, which show in a conclusive manner that the action of these microbes are pathogenic. The epithelium having been destroyed the bacilli pass through the alveolar wall and thus by continuity spread from one cell to another; and their ultimate distribution through the tissues will, of course, depend largely upon their growth and fitness of the soil for development. If they multiply rapidly, caseous pneumonia and extensive excavations of the lung substance will ensue, but if slowly, as Williams observes,* the visitation of their presence may cause an inflammatory thickening of the alveolar membrane, and thus a fibrous barrier, in the economy of Nature's curative art, actually wall them in from further infection.

The fibrinous exudations contain the least number of bacilli of the four groups of histological elements met with in tubercular lesions. These germs are never found in the interlobular tissue, nor very abundantly in the lymphatic system; but their principal haunts are the epithelium of the air cells and their products. Being brought there by inhalation, the bacilli set up an irritation and the alveolus is soon filled with the proliferated epithelia. If the process is gradual, there will be a highly nucleated production of giant-cells, but if the irritation is of marked intensity from the first, caseation rapidly follows. Whether this is due to an over-crowded product, or to some chemical action, as foreshadowed by Dr. Brieger's researches on the nature of ptomaines,* we are not prepared to decide, and further investigations in this line of experimental pathology are now imperatively demanded.

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* Op. cit., page 44.

It is to be hoped, therefore, that a portion of the $15,000 per year donated by Congress for the establishment of one or more Experiment Stations in each of the States and Territories will be applied to the study of this myco-pathological factor in accordance with the wise provisions of the bill; for there is no field of labor that promises a richer reward to the intrepid explorer, nor one from which the returns would more effectually gratify the hearts of afflicted millions.

### DR. KOCH'S EXPERIMENTS.†

FIRST. Four of the six guinea-pigs kept in the same cage, were inoculated in the abdomen, with culture-bacilli of the fifth generation, and on the forty-fourth day of its removal from the human lung. In a fortnight, the inguinal glands of those inoculated were swollen, the wound became ulcerated, and the animals had lost flesh. One died on the thirty-second day, and the rest were killed three days later. The pigs that were inoculated showed extensive tuberculosis of liver and lungs, and the swollen glands had caseated, while the two not inoculated exhibited no trace of the disease in any internal organ.

SECOND. Six out of eight guinea-pigs were inoculated with culture-bacilli of the eighth generation, and the ninety-fifth day of its removal from a tuberculous lung of a monkey, and with similar results.

THIRD. Five guinea-pigs were inoculated with culture-bacilli from the lung of a cow, and all were found upon post-mortem examination to be tuberculous, while the sixth remained perfectly healthy.

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* Micro-Organisms and Diseases, by E. Klein, M.D., F.R.S. Second edition, London and New York, 1885. The Evolution of Morbid Germs, a Contribution to Transcendental Pathology, by K. W. Millican, B.A., M.R.C.S., London, 1883.

† Bacteria in Relation to Disease; Recent Essays by Dr. Koch and Various Authors. Selected and edited by W. Watrous Cheyne, M.D., etc. One of the New Sydenham Series, 1886. Also Dr. Sattler's History of Tuberculosis, 1883.

FOURTH. A hamster-rat and four mice, were inoculated with bacilli that had been under cultivation one hundred and thirteen days. They were killed fifty three days afterwards, and numerous tubercle nodules were found in the spleen, liver, and the lungs.

FIFTH. Three rabbits received a small speck of culture-bacilli in the aqueous chamber of the eye, and within a few days, a severe iritis appeared, and the cornea became cloudy, and of a yellowish gray color. The animals rapidly emaciated, and were killed on the twenty-fifth day. Numerous tubercles were found scattered through the lungs.

SIXTH. A rabbit received an injection of pure blood-serum into the aqueous chamber of the eye; two others, injections of the serum from eyes of animals in last experiment, and with similar results, while the first one remained perfectly sound.

SEVENTH. Four rabbits were inoculated in the eyes as follows: One with pure blood-serum, as before, and without any perceptible effect. The second rabbit, a minimum of the same serum as the two in last experiment. The third and fourth received a larger quantity, several drops of the same fluid. Iritis, panophthalmitis, and rapid emaciation, soon developed in the last two; while in the second, the type at first remained unchanged, but at the end of the second week, a few yellowish-white nodules developed in the iris, and soon a regular tuberculous inflammation over this membranous organ, thus completely obstructing vision. The animals were killed on the thirtieth day, and the first one was healthy. The lymphatic glands near the jaw and ear were swollen in the second rabbit, while in the others, a large number of tubercles were found in both lungs.

EIGHTH. Six rabbits were inoculated in the eye with culture-bacilli, after one hundred and five days' removal from miliary tubercles of the human lung. All were affected with specific iritis, and soon showed symptoms of conjectivitis.

NINTH. Ten out of twelve guinea-pigs were inoculated in the peritoneal cavity, with blood-serum, into which a speck of culture-bacilli had been introduced; the eleventh with pure blood-serum. Five animals died, one each on the tenth, thirteenth, sixteenth, seventeenth, and eighteenth days. The remaining pigs were killed on the twenty-fifth day. The whole ten showed well-marked tubercular infections of the internal organs, while the other two were sound and in thriving condition.

TENTH. A number of white rats were fed for two months, almost exclusively, with portions of dead bodies of tuberculous animals. From time to time, a rat was killed and examined, but only occasionally were any signs of the disease found. Inoculations with tuberculous matter, and with culture-bacilli, had no effect on the animals, although repeatedly made. After several weeks, five of them were inoculated in the peritoneal cavity, with small portions of the culture-bacilli, and in five weeks they were killed, when tubercular nodules were found in the lungs and in the greatly enlarged spleen.

ELEVENTH. Two rabbits received injections of pure blood-serum into the auricular vein. and remained healthy. Ten received the serum and culture-bacilli that had gone through several generations. These soon become emaciated, and began to breathe with difficulty the second week. One died the eighteenth, two on the nineteenth, and so on, and two killed on the thirty-eighth day. Numerous miliary tubercles were found in the liver, lungs, and spleen, as in other experiments.

TWELFTH. Two cats received an injection of blood serum and bacilli into the cavity of the peritoneum. One died on the nineteenth day. The omentum was infiltrated with a white mass, and the spleen was enlarged. The other one was killed on the forty-third day, and tubercles were found in the internal organs.

THIRTEENTH. A bitch received an injection of blood-serum, infected with bacilli, into the peritoneal cavity, but no change was perceptible for the first two weeks. Gradually, however, she became less frisky, lost appetite, and in about ten days a swelling of the abdomen occurred. When killed, the fifth week, a clear, straw-colored fluid was found in the abdominal cavity, with general tubercular infections, as before observed.

The first four experiments conclusively demonstrate that when animals are inoculated in the abdominal cavity, with culture-bacilli, the morbid changes are quite as marked as if fresh tuberculous matter had been used. The next four inoculations were made in the aqueous chamber of the eye, with a view to ascertain whether the artificially cultivated virus would produce the same effect as the natural bacillified tubercle; and, in this connection, I desire to call attention to the fact that false-tubercle which contains no bacilli, and was propagated by non-tuberculous material, such as pus, putrefied muscle, the caseous products of inflammation, cinnabar, aniline dyes, and a variety of vegetable powders, will not produce genuine tubercle by inoculation, as first announced by Drs. Wilson, Fox, and Burdon Sanderson, and I am happy to say that both these men have now revoked their previous claims and assertions.

### THE BACILLIAN PATHOLOGY.

Notwithstanding all the varied and important discoveries in biological science, no investigation has more effectually startled the medico-veterinary world than the appearance of Dr. Robert Koch's address on "The Etiology of Tuberculosis" before the Berlin Physiological Society on the 24th of March, 1882. But the sensation occasioned, on both sides of the Atlantic, by the announcement of his conclusions, was partially due to the distinction which his experimental researches on anthrax had afforded, and his new method of staining micro-organisms gave him a high standing as a practical worker, both among microscopists and mycologists. The achievements in bacteriology had made it quite probable that the cause of tuberculosis was to be sought among these microbes, as had been conclusively demonstrated with other diseases.* Accordingly he directed all his endeavors in this new path of medical science and was wonderfully successful as the sequel proves.

That microscopic fungi, known as the schizophytes, were present in the sputa and other products of the tubercular affections, Koch had practically ceased to doubt, but how to render these minute germs visible, and thus show their etiological relation with the disease, was the question to be solved; and encouraged by past experience in mycological work, he employed the same methods of staining that he had used with such satisfactory results in detecting the bacilli of splenic fever, which was done in the following manner.

The materials for examination were either heated and dried on a cover-glass, or sections are made, after they have been hardened in alcohol. In either case, the specimen is then transferred to a staining fluid, that is prepared by mixing 200 parts of distilled water with one part of a concentrated alcoholic solution of methylene blue and one-fifth of one part of a tenth per cent. solution of caustic potash. The objects are then immersed and remain about twenty-four hours, but by heating this coloring fluid on a water bath, the process can be much shortened. The cover-glasses are then treated with a concentrated aqueous solution of vesuvine, and washed with distilled water.

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*See Dr. A. M. Brown's Treatise on the Animal Alkaloids, Cadreric and Vital, or The Ptomaines and Leucomaines, etc., in relation to scientific medicine. Also, a work on the same subject, by Sir William Aitken, M.D., F.R.S., London, 1887.

Tubercle-bacilli thus treated will appear under the microscope stained blue, while the animal tissues and especially the nuclei of cells are colored brown; and in fact all other bacteria which Koch examined, except the bacillus of leprosy, assume a brownish color also, when subjected to this process. The sections should be treated in nearly the same way for good effect; they are then transferred to the solution of vesuvine, and there remain fifteen or twenty minutes, then washed with distilled water until the blue color has disappeared, when a more or less intense brown color remains. The sections after being placed in alcohol and clarified with oil of cloves, may be examined, or transferred to Canada balsam. But by the Ehrlich process, the germs are red, as seen in the plate; bacilli can be examined without being stained, simply by the addition of a drop of distilled water, or what is better still, the serum of the blood. In this manner of treatment they appear as very fine rods, which possess only molecular movement and have no perceptible motion of their own.

By this method of coloring Koch was enabled to see what hosts of other observers had failed to discover. The microbes thus formed presented some peculiar characteristics. They were rod-shape in form. and therefore belonged to the genus bacillus. These bacilli are very thin, and about a quarter to a half as long as the diameter of a red blood-corpuscle; they closely resemble, both in size and form, the bacilli lepræ, though the latter become stained by Wiegart's method, while those of tuberculosis do not.

The bacilli, according to Koch, are usually present in large numbers, especially where the tubercular process is just beginning, or is progressing rapidly. They are often crowded together in small groups, and sometimes in the form of bundles. They are the most abundant in the interior of the cells, but may also be found at the margin of the large cheesy centers. But after tubercules become fully developed and degeneration sets in, the bacilli become less numerous, and are then found only in small groups, or even isolated, along the margins of tubercle-centers, with faintly colored microbes which are probably these same bacilli that are dead or dying. When giant-cells are present these germs are generally found in the center; and thus remaining as a foreign body, the large cells are developed around them, like encysted tubercle.

In order to determine the extent of this bacilliary infection, Dr. Koch made a series of examinations of tuberculous matter of man and animals, as follows: eleven cases of miliary tuberculosis of the human subject, twelve cases of caseous bronchitis and pneumonia, a case of solitary tubercle in the brain, two cases of tuberculosis of the intestines, three cases of freshly extirpated scrofulous glands, and four cases of fungoid inflammation of joints. The bacilli were abundant in the miliary tubercle of the lungs, the spleen, the liver, and kidneys, also in the gray nodules of the *pia mater.* Swarms of these microbes were found in the caseated bronchial glands. In all the cases of bronchitis and pneumonia the germs were generally confined to the margins of the cheesy infiltrated tissues, but present in large numbers. Sometimes they were found in the interior of the infiltrated portions of the lungs, and in most of the cavities they were very numerous, especially in the largest ones, where other bacteria were to be detected by this staining process, before alluded to, and which is exceedingly valuable in a doubtful diagnosis. In the consumption of the bowels the bacilli were readily demonstrated even from the smaller recent nodules, but in only two of the scrofulous glands were germs, inclosed in giant-cells, visible, and yet the fungoid joints offered no exception to the rule. In fact he examined a large number of organs from various animals affected with this disease, and with similar results. Besides these cases of spontaneous tuberculosis, one hundred and seventy-two guinea pigs, thirty-two rabbits, and five cats, which had been infected by inoculating the gray and cheesy matter from the lung and the sputa of phthisical individuals, were subjects for examination, and in not a single case was the bacilli absent from the tubercle-nodule of the lung.

Though Koch was led to believe from numerous observations that in all tubercular affections of man and animals these special germs were always present, yet he declared in his philosophical mode of expression that "It does not follow, however, that the bacilli thus found are the cause, the starting-point of tuberculosis, although the fact that the bacilli are found in those points especially when the tuberculosis process is just beginning or is progressing rapidly, and disappears when the diseased process ceases, rather favors this supposition." But in order to demonstrate that the disease in question was due to the entrance, growth, and multiplication of these germs, he resorted to a series of experiments which has crowned his life with a diadem of philanthropy which scientific men will ever revere. Koch therefore isolated these bacilli from the body and cultivated them through many generations, purifying them completely from every particle of diseased substance, and finally he inoculated animals with these purified culture-germs, and watched the results.

In making these experiments, every known precaution was employed by disinfecting the spot for inoculation and heating the instrument before using.* He inoculated four to six guinea-pigs at a time with the substance, the virulence of which was to be tested, and the success was constant. In all the animals inoculated with fresh culture-bacilli, the wound generally closed on the following day, and remained unchanged for about a week, when a nodule developed, which either increased in size without breaking, or more frequently changed into a shallow ulcer or a sore. In a fortnight the inguinal glands on the same side became enlarged, and the axillary glands sometimes swollen. At this stage the animals began to emaciate, and either died in four or five weeks or were killed in order to exclude the possibility of a combination with a spontaneous form of the disease.

In the organs of all these animals, and especially in the spleen and the liver, the characteristic, well-known tuberculous changes were found. That the infection of the guinea pig was brought about by this inoculation is evident from the fact that of other animals inoculated with non-bacillary substances, not one became infected. But all those that had been inoculated with material containing bacilli were affected with tuberculosis in a high degree after the lapse of only a month. Bacilli were also again cultivated from the infected animals, and from these similar results were obtained, thus showing the constant occurrence of these specific germs in tuberculosis. He also demonstrated that these bacilli could be derived from tuberculous organs, isolated and purified by artificial cultivation. The most important question, however, remained to be answered, and that is whether the isolated bacilli, when introduced into the body again, would produce the typical pathological changes of the disease in question.

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* See Dr. Antoine Maginn's Bacteria, translated, with Additions, by George M. Sternberg, M.D. With colored plates, 12mo. William Wood & Co., New York, 1884. The Technology of Bacteria Investigation, with Directions for Study, etc., by Ch. S Dolley, M.D., 18mo. Cassino & Co., Boston, Mass., 1885. The Methods of Bacteriological Investigation, by Ferdinand Hueppe. Translated by H. M. Biggs, M.D. 12mo. D. Appleton & Co., New York, 1886.

Some of the most instructive and conclusive observations on this subject, however, are from the pen of Dr. Hippolyte Martin of Paris, on the "Infective Properties of Tubercle."* The object of his experiments was to demonstrate that inoculation with true tuberculous matter, was alone capable of producing the genuine disease, and that all the lesions produced by the introduction of foreign bodies of non-tuberculous nature were not morbid bacilliferous results. He therefore insists that such inoculations should be performed with strict antiseptic precautions, and he declares that if perchance the inoculation of any pseudo article has been followed by an eruption of true tubercle, it is because these precautions have been disregarded. In fact, there is no distinction in the anatomical structure between true and false tubercle, as shown by microscopical examination, and therefore the only means of distinguishing between them is by serial inoculation.

The result of these experiments ought to satisfy every candid mind that the old law, "Like produces like," is true in bacterial pathology; for all these animals, whether inoculated with culture-bacilli in the subcutaneous tissue, or received injections into the peritoneal cavity, the aqueous chamber of the eye, or directly into the circulation, they all became tuberculous, without a single exception, with characteristic nodules, not alone in a single place, but scattered throughout the organs of the body. All these facts, when viewed in the light of a scientific pathology, led Koch to proclaim, with that air of confidence which diligent labor always inspires, that the bacillian germs occurring in the tuberculous substance were not merely the attendants of the diseased process,

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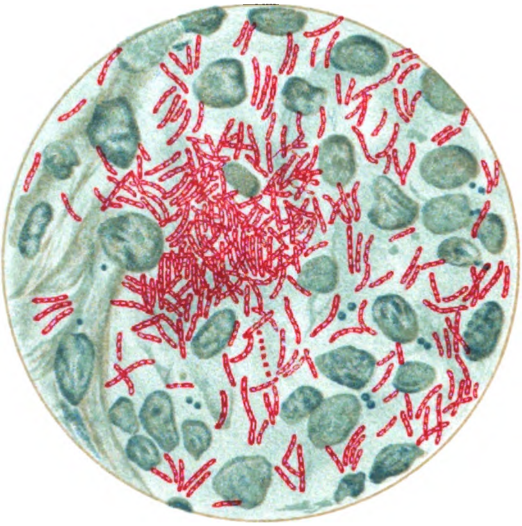
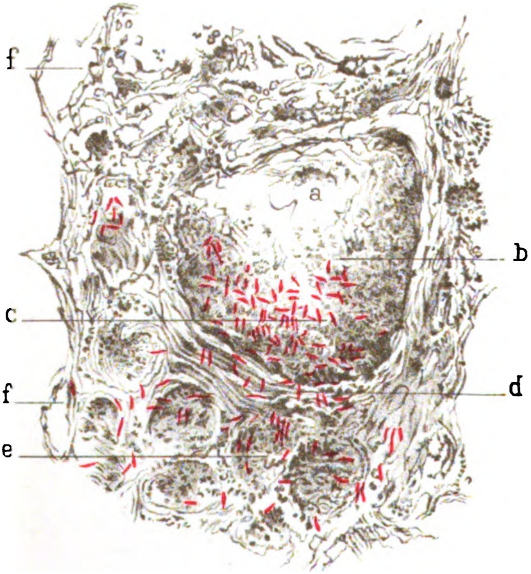
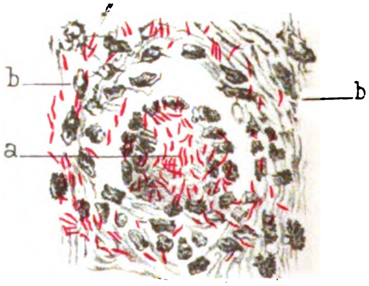
*Archives de Physiologie fur 1881. Also Dr. J. Burney Yeo's Two Lectures before King's College Hospital, on the Contagiousness of Pulmonary Consumption and its Antiseptic Treatment. London, 1882.



BACILLUS TUBERCULOSIS.



Miliary tubercle.



Giant cell from the tonsil.

but the cause of them, and that the bacilli actually represented the *true tubercle-virus.*

Accordingly with this demonstrated, as thousand experiments have truly shown, it will not be difficult to decide what is tuberculosis and what are the pseudo forms of this disease; for it is not the peculiar structure of tubercles, as formerly believed,* nor their want of blood vessels, nor the presence of giant-cells, that will decide the question, but the proof of the presence of the tubercle-bacillus. With these facts as a criterion for investigation, and based upon a long series of experimental observations, Koch declares that all miliary tuberculosis, the caseous forms of pneumonia and bronchitis, tuberculosis of the intestines, the pearly disease of cattle,† and the same in other animals by inoculation, to be one and the same identical malady.

Besides the various works referred to, the reader may consult the following with advantage:—

"The Germ Theory, applied to the Explanation of the Phenomena of Disease, the Specific Fevers," by T. Maclagon, M.D., London and New York, 1874. "The Influence of Heredity and Contagion on the Propagation of Tuberculosis and the Injurious Effects from Consumption of the Flesh and Milk of Tuberculous Animals," by Drs. Lydtin, Fleming, and Hertsen. London, 1884. "Bacilliary Phthisis of the Lungs," by Prof. Germain See. Translated by W. H. Weddell, M.D. London, 1886.

## EXPLANATION OF PLATE.

FIG. 1. *Bacillus Tuberculosis.* From a cover glass preparation of tuberculous pus, stained with Ehrlich's method, Fuchsine and Methylene blue. Magnified 1,500 diameters.

FIG. 2. *Miliary Tubercle.* A. Transverse section of the vein of the human lung. B. Fibrinous clot filling channel of vein. C. Numerous bacilli, as shown at Fig. 1. D. Inferior degenerated wall of vein, also containing bacilli. E. Filled with fibrin and cells, in corners degeneration with some bacilli, the whole containing a tuberculous node. F. A normal pulmonary cellule.

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*Goulstonian Lectures on the Natural History of Pulmonary Consumption, by A. B. Shepherd, M.A., M.D., F.R.C.P. With colored illustrations. Roy. 8vo, London, 1877.

† Bovine Tuberculosis in Man, an Account of the Pathology of Suspected Cases, by Charles Creighton, M.D. Illustrated with colored plates. 8vo. London and New York, 1881.

FIG. 3. *The Giant-Cell.* A. Bacilli filling cell and stained. B. Surrounding tissue, also filled with bacilli.

Fig. 1 is from Crookshank's works, and Figs. 2 and 3 from Prof. See.

The CHAIRMAN. Questions are now in order, gentlemen. The doctor will bear some bleeding. His blood runs pretty freely.

Mr. A. L. COOK. For one, Mr. Chairman, I have been very much interested in the discussion of this question. I have had considerable to do with cattle, and have been seeing this thing which the doctor has described; and still, after hearing him, I am at a loss to know why this trouble should develop itself so suddenly, as it often does, in our young cattle, and strike down within a few hours the best of the herd. But, leaving that question, I wish to ask him to explain to us, if he can, what affects everybody. If the black leg attacks a man's cows it affects his property only, but when any disease gets into our milk-pans it comes home to us, because it puts in jeopardy what is most dear, the lives of our children. I would like to have him tell us if a cow, for instance, develops garget in one-quarter of her bag, whether the other three-quarters are affected by it, and whether the whole of her milk should be thrown away; and also, after she gets over it, whether she is good for the milk-pail?

Dr. CRESSY. I wish the questions might be confined to tuberculosis, as I would like to have all the time devoted to that. I will, however, say a word in relation to the black leg question. When the gentleman speaks of the disease striking down an animal so suddenly he does not refer to tuberculosis. Tuberculosis rarely kills an animal in the time that the gentleman mentions. Generally you will see well-marked symptoms, which will not be easily misunderstood, and which can be readily diagnosed.

I will say that anthrax occurs so suddenly that perhaps that is the disease to which the gentlemen refers. Milch cows are rarely the subjects of its attack, and it usually occurs in young animals.

All garget is not tuberculous. There is the non-inflammatory type, from which cows do not suffer much ; but there is a hardness about the udder, in one-quarter of it or more, and under such circumstances you will find a "garget" that is not easily controlled. When we have a case of true mommetis, which comes on suddenly, its treatment is well understood. The application of cooling lotions and a little aconite is, perhaps, as good as anything that can be prescribed. Saltpetre is valuable as a diuretic, and should be given in teaspoonful doses two or three times a day. If you want to get a decided effect, don't be afraid to give even larger doses of saltpetre. Poke-root is exceedingly good as a general febrifuge. But all three of these combined would not be a specific in every case. If the garget is caused by an injury to the teat from a blow, or anything of that kind, the treatment I should recommend would be to open the bowels by the use of carrots and potatoes, and feeding bran mash, or even a half pound of salts when necessary, and I would see that the animal was protected from cold, and not exposed to inclement weather immediately after calving.

Much of the diarrhea that you find in calves is not the result of any tuberculous disease, but comes from some trouble with the bowels, and death often occurs very suddenly. You will see young calves, especially of the tender Jersey breed, die in two or three days. That is a very common disease, and very fatal, and you will find that where there are many cases it will become epidemic. As Secretary **Gold** has said, "If it is not contagious, it is catching." It is pretty hard to treat it. It is a mucous discharge from the bowels, and should be treated with mild anodynes and astringents.

Mr. **Barnes.** If tuberculosis can be caused by inhalation, why can it not be cured by inhalation?

Dr. **Cressy.** A great many experiments have been tried by evaporation with steam atomizers, and the like, such inhalation processes with medicines, the fumes of sulphur and various other things have been tried, in some cases with very good results. I believe the inhalation process will be exceedingly valuable in the future. The steaming processes that are set up on the germicide theory will be, I think, exceedingly valuable. It is known that many consumptives are greatly benefited by living in the pine forests and inhaling the tar-like atmosphere which prevails there, and it is not unreasonable to suppose that the real benefit comes from the pine tar. There is a good deal of work in the future in the development of the inhalation process.

Mr. **Belden** of Middletown. Did I understand the doctor as saying that tuberculous cows would not breed, and that one cow would take it from another by inhalation?

Dr. **Cressy**. We will assume that we have got a cow that has tuberculosis. It has received the germ, and we have therefore got a diseased condition of the ovary by the deposit of this tuberculous germ, and it has developed there so that the gland is no longer a healthy organ, and therefore the egg is not furnished for conception. Under such circumstances, an animal with that disease settled upon the ovary will not breed. But she will show physical manifestations that will be very marked, and the symptoms alone will be sufficient to diagnose the disease without going any further. She is an animal that will be exceedingly frisky and often in heat, as the result of the fact that that organ is easily excited. It is, I believe, a recognized fact that an animal that is often in heat is one that will not breed.

In answer to the other part of the question permit me to read a little sketch which is in print:

### "CONTAGIOUS BY CONTACT.

"The observations of Dr. **Grad**, veterinary surgeon at Wasselonne, Alsace, on the spread of this disease by contaminated stalls, are very conclusive. On different occasions owners had informed him that they had lost several animals from consumption *in the same stall*. At first he did not attach much importance to the matter, but one day, when visiting the stables of an extensive farmer in Leinheim, he was informed that annually for the last five years one of the cattle had died of tuberculosis in a certain stall. The last one he had the opportunity of examining, which had been there but ten months, had all the symptoms of the malady, greatly emaciated, and troubled with a cough. Dr. GRAD's attention was strongly aroused at such a state of things, and to test the matter scientifically he was allowed to select an animal for an experiment. Accordingly he chose from another stable a three-year-old heifer, in calf, that was to all appearances perfectly healthy. She was bred on the farm, had never been unwell, never coughed, and none of her progenitors had ever been affected with phthisis. The heifer, placed in the stall, remained quite well until after calving, when a slight cough appeared; but it increased in frequency, emaciation gradually set in, with all of the symptoms of tuberculosis, and in twelve months the creature was a mere shadow of her former self. The evidence, therefore, in support of this mode of infection GRAD could no longer resist, as this was the sixth case that had occurred in this stall. Hence he very naturally inferred that the disease was probably transmitted by the ingestion of tuberculous matter expectorated by the cattle which had previously occupied the place."

QUESTION. Would they commence to cough before two or three weeks, or show some symptoms of the disease?

Dr. CRESSY. It would be a very marked case of infection of the lungs if they did. It might be several months before they would show any symptom.

QUESTION. How do you purify a stall?

Dr. CRESSY. By scraping, washing with hot water, whitewashing with chloride of lime, carbolic acid, and crude petroleum, and giving it a thorough disinfection. We usually scrape the boards with an apple-tree scraper, and disinfect the stall as you would where a glandered horse had been.

Mr. ANDREWS of New Britain. Would the doctor consider the frequent occurrence of abortion among stock the result of tuberculosis?

Dr. CRESSY. I am rather inclined to think there are new elements there that are worthy of investigation. It is a fact, I believe, that many cows that are tuberculous are liable to abort, and a new question has just come up with the germ theorists, whether the tuberculous germ may not be the cause of abortion in many cases. But the question whether the animals have not been abused in some way, or driven by dogs, should be taken into consideration first.

Mr. **Stone.** If we find that condition of the lungs to which you have referred, what are we to infer from that?

Dr. **Cressy.** If a portion of the lung is filled with yellow matter and shows hard tubercles, it is most likely tuberculosis. But if a cow has had a bad cold, or pneumonic symptoms, you might get pleuritic conditions of the lungs and pleura without any tuberculosis whatever. We often have diseases of the lung where it will cut open like a piece of liver, and have a yellow, cheesy appearance. That takes place in many cases of pleuro-pneumonia where the disease has run into the chronic stage.

Col. **Warner.** I would like to ask the doctor what he would do with the carcass of an animal that died of tuberculosis?

Dr. **Cressy.** Burn it or bury it.

Col. **Warner.** Would you bury it?

Dr. **Cressy.** Buried very deep, so that domestic animals could not get at it, I do not think it would do any harm.

Col. **Warner.** Would there not be danger of these germs being brought to the surface by worms?

Dr. **Cressy.** Darwin has found cases where fish-worms have brought these germs to the surface, as you suggest. His observations inclined him to think that if the carcass is not buried more than eighteen inches the whole surface will become infected. Dr. Axe, one of the professors of the Royal Veterinary College of London, detailed a case a few years ago, in the *Veterinarian*, to this effect: That an animal died somewhere near London of anthrax, was left to rot upon the ground, and the grass grew luxuriantly over it. After a time some cattle were turned into the field, and one of these animals, by accident, went to this spot and ate freely and eagerly this fresh, luxuriant grass. The result was that in forty-eight hours that animal sickened and died. Some people believe that the grass itself is capable of taking up these germs, but I hardly think that is so. I think the grass was more or less dirty, and that the earth contained the germs. Under such circumstances the disease would spread very rapidly. I have seen several cases in this State where similar results have occurred. I believe as you say, Colonel, that to be absolutely safe it would be necessary to burn the body.

Col. **Warner.** How long will these germs remain in the soil and retain their vitality?

Dr. **Cressy.** I do not know, but some of them very long indeed. In the dried state they will live for years, but how long they will live in the soil is not known. Little or no experimenting has been done in that line. Darwin's observations are the best on record now.

Mr. ————————. I deem it important for every farmer to know whether his cattle are infected with this disease or not. One of my cows this last spring was taken with coughing, and during the season the remainder of the dairy were coughing in the same way. This winter, after putting the cows in the barn, they did not cough at all. They are in good flesh, give a good quantity of milk, and are apparently healthy. What was the matter with these cows?

Dr. **Cressy.** A doctor would like to make a particular examination, I presume, before giving an opinion. It would be merely guess-work on the part of anybody to volunteer an opinion without an examination. It might be simply a case of distemper, such as we often see cattle and horses suffering from. We had a similar case several years ago, about 1879, in Waterbury, where the Porter Brothers' herd were supposed to have been attacked with pleuro-pneumonia. The Cattle Commission were notified and made several visits. It turned out to be a case of distemper. All the cattle recovered, and came out of it in good shape. They were coughing badly, as the gentleman has described in his case, and there were some suspicious circumstances. It was one of the finest herds in the State, and it would have been a great misfortune to have had pleuro-pneumonia or any contagious disease make its appearance among them.

Adjourned to 2 o'clock.

## AFTERNOON SESSION.

The Convention reässembled at 2.15, Vice-President **Day** in the chair.

The **Chairman**. The subject of the lecture this afternoon, "Differences in Dairy Products," like those that have preceded, is one of great interest to all the people of this State, and to the people of the United States. I have the pleasure of introducing Maj. **Alvord**, Professor of Agriculture at the Massachusetts Agricultural College, who will address you upon that subject.

## DIFFERENCES IN DAIRY PRODUCTS.

### By Henry E. Alvord.

Milk is a fluid, and has been so regarded from time immemorial. It has been bought and sold by liquid measure. And in referring to the use of milk it is ordinarily spoken of as a fluid. We say, commonly, that we drink milk, and rarely speak of eating it. Yet milk is food rather than drink. It is the perfect food provided by Nature for the young of the most important grand division of the animal kingdom. And we know it as largely consumed as food by human beings of all ages. It is, then, as a food, that milk, and chiefly the milk of the cow, is so conspicuous in commerce and in domestic economy. But our first idea of human food is a solid substance, and although some food appears in liquid form, it is valued for the solid matter it contains. Milk is no exception. It is a fluid because largely composed of water, but all its other constituent parts are solids, and they are what give milk its food value. Some of these constituents, the curd, or caseine, the sugar and the salts, or mineral matter, are dissolved in the water; other parts, the fats, are in semi-solid particles, held in suspension in the fluid, causing the opaque appearance. So milk is at once a solution and an emulsion. (By 'emulsion,' a word itself meaning milk-like, we intend to describe a physical mixture of different substances, like oil and water, which do not form a chemical union.) To thoroughly understand milk, its composition and value, it must therefore be examined both chemically and physically.

Chemical examination reveals the fact that milk varies greatly in its composition, or rather in the relative quantity of its parts. By carefully evaporating the water we secure all the other parts, and these collectively are called the "total solids" of the milk. The fat may then be easily separated from the rest and its quantity determined, the remainder being what are known as the "solids not fat." These, in turn, are usually separated into caseine, sugar, and salts, or ash. The notable differences in milk are in the proportions of fat to the other solids, and of the total solids to the water. The range of total solids is from below 11 per cent. to above 20 per cent.; it is unusual, however, to find pure milk from a healthy cow, with much less than 12 per cent. solids, and over 16 per cent. is also uncommon. The highest record found for a single cow is 23$\frac{43}{100}$ per cent., and the lowest 10$\frac{65}{100}$ per cent., the former a Jersey, and the latter a Holstein; and the highest for a herd for any length of time is 15$\frac{45}{100}$ per cent. for a herd of registered Jerseys in the State of New Jersey, tested for one full year, and the lowest, 11$\frac{77}{100}$ per cent., for forty-five Dutch cattle at Proskau, for over two years, as reported by Dr. Schmoeger in the *Milch Zeitung* for 1881. The range of fat is even greater, proportionally, being from 2 per cent. (or even less) to 12 per cent.; but 3 per cent. is as low as allowable for pure milk from a well-kept cow, and anything over 6 per cent., maintained for any length of time, is very rare. The fats of milk being included in the solids and the most variable portion, we naturally find most fat with the most solids, and the least fat with the lowest total solids, and *vice versa*. The highest and lowest records of fat which I have seen for single cows, are 12$\frac{53}{100}$ and 2$\frac{70}{100}$ per cent., being the same animals previously referred to, as showing the extremes for total solids; both were examined at the New York Agricultural Experiment Station.

Physical examination, chiefly with the microscope, shows the condition in which the fat is held in the serum, or fluid, and demonstrates great differences in this particular, in the milk of different cows. The fat is found in globular form, myriads of these minute globules floating at will in the otherwise colorless fluid, and giving to milk a physical character and quality quite distinct from its chemical quality. The main differences in these fat globules are in their average size and their uniformity of size, as seen in different milks. It requires from 1,500 to 10,000 of these fat globules, placed side by side, to cover a line an inch in length; from 6,000 to 7,000 is a fair average. Sometimes, but not often. globules are formed as large as $\frac{1}{1000}$ of an inch in diameter, and in most milk there are those so minute as to be called granules, to distinguish them, and which are $\frac{1}{35000}$ of an inch, or less, in diameter. Dr. Sturtevant, as the result of thousands of examinations, reported the average size of the fat globule in Jersey milk as $\frac{1}{5253}$ of an inch, and in Ayrshire milk, $\frac{1}{7080}$ of an inch; the average size for Dutch or Holstein milk was still smaller. The larger the fat globules in any milk, the easier and quicker they separate from the fluid, and the more difficult it is to re-mix the parts; that is, the cream and the skim-milk. I quote from Dr. Sturtevant on this subject of the differences in milk as regards its physical character: "The globule of the milk of the Jersey breed is larger than of other breeds examined, and there are fewer granules; as a result, the cream rises with considerable rapidity and so completely as to leave a very blue skim-milk, which does not readily re mix with the cream. The milk of the Ayrshire breed furnishes a globule intermediate in size between the Jersey and the Dutch, and a predominant feature is the presence of numerous granules, or extremely small globules, which give a white rather than a blue appearance to the skim-milk. Of the three breeds we are considering, the Dutch, or American-Holstein, presents the smallest globule to its milk. The globules are more uniform in their size than in the Ayrshire milk, and there are fewer granules. The cream, on account of the uniformity of the size of the globules, rises completely, making the skim-milk appear blue, and on account of their small size the cream can be readily mixed with the skim-milk by shaking." Prof. Arnold adds, on this point: "The milk of Devons resembles closely that of Jerseys; the milk of native cows is usually similar to that of the Ayrshires, and the milk of Shorthorn cows somewhat resembles that of the Dutch, but the globules are larger and not so uniform in size or quality."

Investigations in another direction have determined what may be called either physiological or hygienic differences in milk. The character of the solids, and particularly of the fats and caseine, appear to differ in their character as regards digestibility. The caseine is believed by some to be more or less in a solid form, instead of all dissolved, and this solid portion varies greatly in different milks. This variation makes one milk much more wholesome, or easier of digestion, than another, which becomes a matter of importance in the case of infants and invalids. Furthermore, milk differs in the matter of color. Some cows, as a part of their animal economy, have the power of secreting, in various parts of the body, an orange-colored pigment. This coloring matter has a special affinity for the fatty tissues and appears in the fats of the milk. In this respect, as stated, cows differ greatly, but the matter of color seems to have no relation whatever to the quantity or other qualities of milk. It is certain that color is in no respect an indication of the quantity of fat in the milk, or of the butter that milk will produce. Erroneous views on this point have led to undue value being placed on high-colored milk and cows producing such. Repeated trials have shown that cows whose bodies and milk are destitute of this often-prized quality, yield milk richer in the quantity and quality of butter produced from it, than other cows specially selected for their high development of this peculiar attribute of color.

Although the variations in milk, as described, appear more or less among cows of the same breed, and more decidedly among animals of mixed blood, it has been well established that the contrast is most marked between pure bred cows of the several recognized dairy breeds of cattle. The differences in the milk from these breeds is so positive as to be now regarded as characteristic of the breed themselves. Thus, high medical authority pronounces the Ayrshire milk to have special hygienic properties which adapt it, above all others, to the use of infants and invalids. The predominating feature of Guernsey milk is the deep orange color which becomes imparted to the butter. The cattle of Holland and Holstein are noted for yielding enormous quantities of milk very low in fat and other solids; the physical character of this milk is such that it is the very best of all for shipping long distances, and for city delivery as "dip milk." And the Channel Island cattle, the Guernseys and the Jerseys, give the highest per cent. of fat and of total solids, together with high color. *The differences which are to be found in milk and the products of milk, are then mainly a difference of breeds.* The study of the characteristics of the milk of different breeds of cattle has, therefore, a direct practical bearing, and becomes of interest to all consumers who are discriminating buyers, and to all producers whose business sense leads them to take every advantage of a discriminating market. Heretofore there has been difficulty in pursuing this study because of the lack of sufficient authentic data. In the old records, of which there is a great mass, we have widely varying results from the examination of milk, cheese, and butter, but they are valueless as bearing on the question of breed, because rarely, if ever, do such records give any history of the origin of the substances examined. Facts of a more complete and satisfactory character have been accumulating of late years, however, and while it is not unlikely that further data will cause some modification of existing averages, and the deductions to be made from them, we have now enough to at least make a very interesting subject for study, and to lead to some well-defined conclusions.

My attention has been attracted, for two or three years, by the discussions of human foods and the different ways of comparing them. I have been especially interested in noting the high position occupied by dairy products as economical articles of food. And this paper was suggested by, and is mainly based upon, certain tables, with their explanations, which are to be found in the proceedings of recent meetings of the American Association for the Advancement of Science. Those relating to the differences in milk, or rather the variation in the food value of different milks, and comparing dairy products in this respect with other articles of food, were presented in the Economic Section of the Association, and the one on variations in butter was presented in the Chemical Section and also contributed to the last meeting of the Society for Promoting Agricultural Science, and published in its proceedings for 1887. With such endorsement, we may rely upon the accuracy and value of these data, and may deduct some important facts from their consideration.

The tables to which I first call your attention were prepared two years ago, in connection with a discussion of "the food question," to illustrate the "Relative Values of Human Foods," upon the basis of their chemical composition. They have been amplified and re-arranged within the past year, separating the long list of dairy products from the other foods and giving a new title suited to my present use of them. (Tables illustrating the Differences in Dairy Products and comparing the latter with various other standard Food Products.) The figures as presented to the American Association remain unchanged, and they represent a very large number of authentic analyses, the average of all analyses of like articles of undoubted history, which could be found recorded, upon reliable authority, up to the 1st of July, 1887.

There are different ways of comparing human foods upon the score of economy. If one attempts to consider at once their digestibility, chemical composition, and usual cost, besides other conditions which should not be ignored — nervine properties, for example — the problem becomes very complex. It is hard to define the average human stomach, and we are so much in the dark on the questions of actual digestion and assimilation of different forms of food, that it is safer to drop this factor than to include it. At all events it is better to approach the subject by stages, and in this instance we consider, in combination, the chemical knowledge of foods and their market prices. The basis of comparison is all-important. The necessity is apparent of separating foods into two grand divisions, animal and vegetable, and of selecting a basis for each. It is needless to here fully explain the manner in which these tables were prepared. For the details, reference is made to the original form of publication. (Vol. XXXIV, *Am. As. Adv. Science,* 1885, page 504.) The statement is sufficient, now, that pure lard at 12 cents per pound, and average ox-beef, flesh free from the bone, at 16 cents per pound, taken as the basis, give the average cost of the nutrients in animal foods, as 72 cents per pound for protein, 12 cents for fats, and 7 cents for carbo-hydrates. This assumes the proper ratio between fats and carbo-hydrates to be $1\frac{75}{100}$ to 1 ; so that to combine these two, the quantity or per cent. of fat in any analyses is multiplied by $1\frac{75}{100}$ and added to the carbo-hydrates. For vegetable foods, the potato at 60 cents a bushel or one cent a pound, is the basis, and the value of vegetable protein thus fixed at 10 cents per pound, and of carbo-hydrate, 4 cents per pound.

Based upon these values, the following tables have been compiled. They give the chief nutrients, the computed value, and the average price, approximately, of 100 pounds each of about thirty different dairy products, and, for comparison, an equal number of other common articles of food, one-third animal and the rest vegetable. A column is added at the right of each table, indicating by the signs plus (+) and minus (—), whether the usual selling price, as stated, is more or less than the computed food value.

TABLE ILLUSTRATING THE DIFFERENCES IN DAIRY PRODUCTS, AND COMPARING THE LATTER WITH VARIOUS OTHER STANDARD FOOD PRODUCTS.

| Milk from various different breeds of cows, with butter, cheese, etc. | Lbs protein in 100 lbs. | Lbs. Carbo-Hydrates do. | Computed value per 100 lbs. | Average market price do. | Price Greater [+] or less [—] than value. | |
|---|---|---|---|---|---|---|
| Cow's milk, chemists' standard, | 4.00 | 10.62 | $3.62 | $3.25 | — | a |
| Cow's milk, average all analyses, | 3.41 | 11.23 | 3.24 | 2.79 | — | b |
| Milk of Galloway cow, | 5.36 | 8.86 | 4.45 | 3.25 | — | a |
| Milk of Bengali cow, | 5.19 | 10.07 | 4.44 | .... | — | .. |
| Milk of Devon cow, | 4.37 | 12.56 | 4.02 | 3.25 | — | a |
| Milk of Jersey cow, | 3.98 | 13.88 | 3.82 | 3.50 | — | c |
| Milk of Guernsey cow, | 3.97 | 13.63 | 3.81 | 3.50 | — | c |
| Milk of Brittany cow, | 3.96 | 10.89 | 3.76 | .... | — | .. |
| Milk of Danish cow, | 3.90 | 10.69 | 3.56 | .... | — | .. |
| Milk of Ayrshire cow, | 3.76 | 11.65 | 3.54 | 3.25 | — | a |
| Milk of Shorthorn cow, | 3.74 | 11.83 | 3.52 | 3.25 | — | a |
| Milk of Kerry cow, | 3.40 | 10.96 | 3.21 | .... | .. | .. |
| Milk of Dexter [Irish] | 3.35 | 11.05 | 3.20 | .... | .. | .. |
| Milk of Holstein cow, | 3.15 | 9.67 | 2.95 | 3.25 | + | a |
| Milk of Hollander cow, | 3 03 | 10.65 | 2.93 | 3.25 | + | a |
| Milk of Fribourg cow, | 2.84 | 11.68 | 2.86 | 3.00 | + | d |
| Milk of Dutch cow, | 2.78 | 11.42 | 2.80 | 3.00 | + | d |
| Goat's milk, | 3.80 | 12.98 | 3.65 | .... | .. | .. |
| Sheep's milk, | 7.12 | 14.67 | 6.15 | .... | .. | .. |
| Skim milk [cow's], | 3.06 | 6.15 | 2.63 | 1.77 | — | e |
| Buttermilk, | 3.78 | 5.89 | 3.13 | 1.77 | — | e |
| Condensed milk, | 16.07 | 60.06 | 15.77 | 20.00 | + | .. |
| Cream, average, | 3.70 | 48.51 | 6.06 | 12.50 | + | .. |
| Butter, average of all, | 0.86 | 146.15 | 10.67 | 25.00 | + | .. |
| Butter, Jersey, | 1.30 | 152.78 | 11.41 | 30.00 | + | .. |
| Butter, Ayrshire, | 1.40 | 151.81 | 11.42 | 25.00 | + | .. |
| Butter, Holstein, | 2.65 | 143.55 | 11.82 | 25.00 | + | .. |
| Cheese, full cream, average, | 27.16 | 55.78 | 23.46 | 15.00 | — | .. |
| Cheese, pure Jersey m'k, | 28.18 | 64.81 | 24.48 | 15.00 | — | .. |
| Cheese, half skim, | 27.62 | 38.92 | 22.61 | 12.00 | — | .. |
| Cheese, skim milk, | 32.65 | 21.50 | 25.01 | 10.00 | — | .. |
| Cheese, whey, | 8.88 | 66.91 | 11.08 | ..... | .. | .. |

NOTE. a, a, at rate of 7 cents per quart; b, 6 cents per quart; c, c, 7½ cents per quart; d, d, 6¼ cents per quart; e, e, 4 cents per quart.

### TABLE ILLUSTRATING THE DIFFERENCES IN DAIRY PRODUCTS, AND COMPARING THE LATTER WITH VARIOUS OTHER STANDARD FOOD PRODUCTS.

| SECOND PART. Standard articles of human food. | Lbs. protein in 100 lbs. | Lbs. Carbo-Hydrates do. | Computed value per 100 lbs. | Average market price do. | Price Greater [+] or less [—] than value. | |
|---|---|---|---|---|---|---|
| Beef, without bone, average, | 21.39 | 9.08 | $16.32 | $16.32 | — | .... |
| Veal, medium fat, | 18.88 | 13.89 | 14.57 | 15.00 | + | .... |
| Mutton, medium fat, | 14.80 | 63.73 | 15.12 | 15.00 | — | .... |
| Pork, fat, | 14.54 | 65.35 | 15.04 | 13.00 | — | .... |
| Fowl, domestic, | 18.49 | 17.54 | 14.54 | 16.00 | + | .... |
| Hen's eggs, | 12.55 | 21.74 | 10.56 | 10.65 | + | f |
| Salmon, | 13.10 | 12.67 | 10.32 | 30.00 | + | .... |
| Mackerel, | 23.42 | 11.83 | 17.69 | 10.00 | — | .... |
| Codfish, dried, | 17.90 | 2.25 | 13.05 | 8.00 | — | .... |
| Oysters, | 4.95 | 3.27 | 3.97 | 10.00 | + | .... |
| Fine wheat flour, | 8.91 | 76.12 | 3.94 | 3.00 | — | .... |
| Coarse wheat flour, | 11.27 | 75.79 | 4.16 | 2.50 | — | .... |
| Oat meal, | 15.50 | 74.37 | 4.52 | 3.00 | — | .... |
| Corn meal, | 12.17 | 78.02 | 4.55 | 1.50 | — | .... |
| Fine wheat bread, | 6.82 | 53.69 | 2.83 | 4.00 | + | .... |
| Coarse wheat bread, | 6.23 | 51.32 | 2.67 | 3.00 | + | .... |
| Potatoes, | 1.79 | 20.84 | 1.01 | 1.00 | — | .... |
| Rice, | 1.81 | 76.61 | 3.24 | 6.00 | + | .... |
| Beans, | 23.56 | 52.10 | 4.44 | 4.00 | — | .... |
| Peas, | 22.63 | 56.25 | 4.51 | 5.00 | + | .... |
| Cabbage, | 2.95 | 9.24 | 0.66 | 1.00 | + | .... |
| Onions, | 1.68 | 10.99 | 0.61 | 2.00 | + | .... |
| Tomatoes, | 1.25 | 4.66 | 0.31 | 2.00 | + | .... |
| Sugar, from cane, | 0.35 | 96.73 | 3.90 | 6.00 | + | .... |
| Honey, | 1.29 | 81.43 | 3.39 | 25.00 | + | .... |
| Apples, | 0.39 | 13.74 | 0.59 | 1.50 | + | .... |
| Dried apples, | 1.06 | 55.97 | 2.35 | ..... | + | .... |
| Peaches, | 0.65 | 12.57 | 0.57 | ..... | + | .... |
| Strawberries, | 1.07 | 8.48 | 0.45 | ..... | + | .... |
| Grapes, | 0.59 | 17.11 | 0.74 | ..... | + | .... |
| Banana, yellow, hard, | 1.41 | 30.85 | 1.23 | ..... | + | .... |
| Banana, fully ripe, | 4.82 | 20.96 | 1.32 | ..... | + | .... |

NOTE. f, 16 cents per dozen.

Certain general explanations and remarks should be made in regard to these tables before referring to any special points of interest. In each table the first column gives the name of the article of food to which the figures on the same line apply. The remaining columns in the two tables are duplicates in their headings and object. The column headed "Protein" gives, in pounds and hundredths of a pound, the average quantity found in 100 pounds of the article named. By protein is meant that class of compounds, the most important of all the ingredients of food, whose four elements are carbon, oxygen, hydrogen, and especially nitrogen (with perhaps a little sulphur or phosphorus). Under the head of protein are therefore included what are variously called albuminoids, gelatinoids, nitrogenous parts, and proteids, the most familiar example of which is the albumen or "white" of eggs. The next column, headed "Carbo-hydrates," gives, likewise, the quantity of this class of nutrients in 100 pounds, expressed in pounds and decimals. These substances include sugar, starch, dextrin, digestible woody fiber, etc., which, as well as fats, are composed of the three elements, carbon, oxygen, and hydrogen. It should be especially noted that in these tables, to save a column and simplify their appearance, special columns for fat have been omitted, and the fats have been included in the columns of carbo-hydrates, being first reduced to an equivalent, on the ratio previously stated. This accounts for the apparent anomaly of the figures in this column in some cases (butter, for example) indicating more than one hundred pounds of carbo-hydrates in a hundred pounds of the article named. The explanation is as given,— that the fat, having the higher nutritive value, has been multiplied by 1.75, before adding to the carbo-hydrates proper. The reason undoubtedly was, that the nutritive parts of food are commonly (if not correctly) classed as flesh-forming, and heat-producing, or life-sustaining; fats and carbo-hydrates both belong to the latter class, and hence are expressed in combination. In these tables, therefore, the protein columns represent flesh-forming parts of the food, and the carbo-hydrate columns heat-producing parts. (It is a recognized fact, that this last classification is defective in several particulars, but especially because the protein of food may be changed in the body into fats and carbo-hydrates, and serve, as do the latter, for fuel in sustaining animal life and heat.) These two columns are based upon fixed facts determined by chemical research and not liable to change, although slight modifications may result from adding new analyses, and the articles may, in the course of time, while maintaining the same name, acquire new characteristics. The next column, headed "Value," is based upon those before, with the rates assigned for protein and carbo-hydrates, per pound, in animal and vegetable substances, and thus gives the actual value of the nutrients in 100 pounds of the foods named, computed upon their chemical composition. If exceptions are taken to the assumed prices of the basic articles, it is manifest that, by a simple calculation based upon existing market rates, the columns of food values may be easily reconstructed to suit any given locality. As the figures stand, however, they are relatively correct and serve our purpose better, in comparing different foods, than do those of the previous columns. The columns of average market price are simply for illustration, and will vary more or less with time and place. The purpose of the signs in the right-hand columns has already been explained.

It may be noticed that the tables do not include the mineral constituents of food, which are usually denominated the ash. No diet is complete without some mineral ingredients, and in milk for babes these are an important factor. But sooner or later after we begin to crawl — and sooner, rather than later — we all, it is said, "eat our peck of dirt," so that this omission may be regarded as unimportant, and perhaps be thus accounted for.

For the single object of showing the differences in dairy products, and hence for this occasion, we should have found it more satisfactory to place the fats in a separate column, and to add a column of total solids. But I thought it best to use the tables as originally published, rather than change any figures.

At this point, attention is especially invited to the demonstration given by these tables of the cheapness, when compared with their nutritive value, of nearly all dairy products (butter excepted). Skim-milk, butter-milk, and cheese, at their usual retail prices, are cheaper as nutritious food than any other articles on the list, and are approached in this respect only by fresh mackerel and dried codfish. Butter is an exception, and while it unquestionably serves special purposes in the human diet, it must, upon the basis of its chemical composition, be regarded as a delicacy or luxury, and not as a food; it ordinarily costs two or three times its real food value, and often more. Of the more solid foods, not specially perishable, nothing begins to compare in cheapness with cheese. What shall be said of the domestic economy of America, where more butter and less cheese are consumed *per capita* than in any other nation in our zone? And what of the wisdom of the law makers, in some of our States and great cities, who, to escape the difficulties of regulating the milk traffic, utterly ignore the whole question of cheap and wholesome food for the poor, and, sanctioned even by boards of health, absolutely prohibit the sale of skimmed milk, and actually authorize the destruction of all that can be found !

Now, let consideration be confined to that part of the first table which relates to milk. Great differences are here shown in the composition, and hence the value, of the average milk of cows of different breeds. It is worthy of notice that the milks which, as shown in the column for carbo-hydrates, have the most fat are, as a rule, also the richest in protein, or curd. This table indicates at once the breeds of cattle whose milk we should buy, if consumers, and which we should keep, to be the producers of milk of high quality. The milk of the chemist's standard, average cow's milk (as determined by very many analyses), and of all the breeds enumerated, except four, usually sell for less than their computed value. Four breeds, all of the same general class of stock, yield milk so low in its nutrients that it is, on the average, not worth the prices at which it commonly sells. This difference in value would be still more marked if the same selling price was assigned to all milk, but special allowance is made in the table for higher prices of milk of exceptional richness, and low prices for that of poorest quality.

Manifestly, we do not buy milk, and we are foolish if we produce it, for the water it contains. The greater the proportion of water, the poorer, less valuable the milk. It is the solid portion, and that only, which gives milk its food value, and I firmly believe the time is near at hand when its commercial value will be fixed by the total solids. To illustrate: compare the milk of one of the breeds of high quality and one of those of a low standard, with the general average. We will take the fourth from the top, the Jersey, and the fourth from the bottom, the Holstein, as being familiar breeds, and expand the figures of the table, to give the full average analyses:

| Kind of Milk. | Water. | Solids. | Casein. | Fat. | Sugar. | Ash. | Value pr. cwt. |
|---|---|---|---|---|---|---|---|
| Maximum, Jersey, | 85.18 | 14.82 | 3.98 | 5.06 | 5.03 | .75 | $3.82 |
| Mean, average of all, | 87.31 | 12.69 | 3.41 | 3.66 | 4.92 | .70 | 3.24 |
| Minimum, Holstein, | 87.92 | 12.08 | 3.15 | 3.30 | 4.90 | .78 | 2 95 |

A graphic illustration is more satisfactory than the mere figures.

(NOTE.—Three sets of glass jars, six in each, were here exhibited, showing respectively the component parts of one gallon of each of the three grades of milk represented by the figures just above, and in the foregoing table. And remarks were made as to the difference in composition of these representative samples of milk.)

Good cheese is made from whole milk, or that from which no part of the cream has been taken. In old times little else was thought of Now so many inferior kinds are made that the designation "full cream cheese" is given to the standard product of first quality. The differences in this class of dairy products, to which I will briefly refer, are not those incident to the processes which result in "skims" and "filled" cheese (lard or oil substituted for fat removed in cream), but relate to the variations occurring in the quantity and quality of full cream cheese made from an equal weight of whole milk from different breeds of cows.

One would not at first think that milk of extreme richness of fat or cream, and specially adapted to butter-making, would be desirable for cheese. But in well-made cheese a very large share of the total solids of the milk are secured in the product,—nearly all the caseine and the fat, although most of the sugar escapes in the whey. Consequently that which is richest in total solids will make the most cheese per hundred-weight of milk, and the general statement is true that milk best suited to butter is most profitable for cheese. The data regarding cheese made from the milk of pure-bred cows of different breeds is meagre, but the principle stated is borne out by experience with Jersey milk. The general average in good cheese-making districts is ten pounds of cheese to every hundred-weight of milk; with milk from pure Jerseys, in large number, on the common factory plan, it has been found that the same weight of milk will give over twelve pounds of cheese, a gain of more than 25 per cent. in quantity of product. At several public exhibitions in Canada during recent years, and also at the Ontario Experiment Farm, the milk from selected cows of different breeds has been tested in various ways, and with reference to the available curd, or cheese-making qualities, among the rest. (The animals being few in number, I do not regard these results as alone settling any points of comparison, but they may serve in corroboration of other statements made.) The details have been widely published, so it is sufficient for present purposes to state the general results. The order of merit as cheese-makers indicated was as follows: First trial—Jerseys, Shorthorns, Ayrshires, Guernseys, Devons, Galloways, Holsteins, Polled Aberdeens. Second trial — Jerseys, Ayrshires, Shorthorns, Holsteins. Third trial — Jerseys, Ayrshires, Devons. In the second trial the Ayrshires led on quantity of curd without fat, but with curd *and* fat took second place. With this exception the Jerseys stood first in quantity of curd, as well as of fat. In regard to the quantity of caseine alone, in the milk of different breeds, the table previously referred to shows this relation with approximate accuracy, in the column headed protein.

The same table gives the differences in chemical composition and computed value between average full cream cheese, the same made from pure Jersey milk, half skim cheese, and that made from skim-milk and from whey. There is very little light here as to the merits of different breeds of cattle as respects the quality of cheese made from their milk, although the surprising fact is shown that Jersey-made cheese is so much richer in both caseine (proteids) and fat, that it is worth a cent a pound more than the average full-cream cheese of America, as an article of nutritious food. Upon this point Prof. Arnold says in his "American Dairying": "The business of the Jersey cow is emphatically that of butter-making. Her milk, however, is rich in cheese matter, and, contrary to the general belief, is capable of making as fine cheese as it does butter. It is a new feature, worthy of note in the uses of this breed of cattle, that their milk can, without the waste of its buttery matter, be converted into a strictly fancy cheese, as rich as English Stilton. Analyses of cheese from pure Jersey milk, made at Cornell University, have shown over forty per cent. fat."

The table upon which we have been depending gives so little in regard to differences in cheese, that I append another, with considerably more data in this connection :

TABLE OF ANALYSES OF DIFFERENT KINDS OF CHEESE.

| | Description of Cheese. 100 Pounds. | Water. Lbs. | Fat. Lbs. | Protein or Curd. Lbs. | Ash. Lbs. |
|---|---|---|---|---|---|
| 1. | Average of 88 samples, Full Cream cheese, | 35.75 | 30.43 | 27.16 | 4 13 |
| 2. | Average of 21 samples, N. Y. State Dairy Commissioner's Report,................ | 27.82 | 28.61 | 38.10 | 4.39 |
| 3. | Full Cream (Flint's Dairy Farming of pure Jersey milk),......................... | 38.46 | 31.86 | 25.87 | 3.81 |
| 4. | Full Cream, Premium at N. Y. State Fair, | 28.37 | 31.28 | 36.52 | 3.83 |
| 5. | Full Cream, Premium at N. Y. State Fair, | 28.62 | 29.90 | 37.66 | 3.82 |
| 6. | Full Cream, Premium at N. Y. State Fair, | 33.75 | 28.95 | 33.70 | 3.60 |
| 7. | Full Cream,.............................. | 28.11 | 41.03 | 28.18 | 2.68 |
| 8. | English Average, by Sir Lyon Playfair,... | 38.78 | 25.30 | 31.02 | 4.90 |
| 9. | English Cheddar, 2 years old, Prof. Johnston, .............................. ... | 36.04 | 30.40 | 28.98 | 4 58 |
| 10. | English Double Gloucester, 1 year old, by Sir Lyon Playfair,...................... | 35.81 | 21.97 | 37.96 | 4.25 |
| 11. | English North Wilts, 1 year old, Prof. Johnston, ............................ | 36.34 | 28.09 | 31.12 | 4.41 |
| 12. | Half-skim, average of 8 English samples... | 46.82 | 20.54 | 27.62 | 3.05 |
| 13. | Half-skim, N. Y. State, ................... | 38.35 | 19.93 | 38.48 | 3.25 |
| 14. | Skim-milk average of 9 English samples,.. | 48.02 | 8.41 | 32.65 | 4.12 |
| 15. | Skim-milk, English, 1 year old,........... | 43.82 | 5.98 | 45.04 | 5.18 |
| 16. | Whey Cheese, average 6 samples,.... .... | 23.57 | 16.26 | 8.88 | 4.76 |

One product of the dairy only remains to be considered. This is butter, the culmination of the dairyman's art. This great delicacy consists of the natural fat of milk, with some water, and should contain nothing else, except as we choose to flavor it with salt. The perfection of butter-making is to secure these fats, separated from the serum or fluid of the milk, and gathered in a mass, with as little chemical and physical change as possible. So it may be said we *get* the butter from the milk, rather than "make" it. Unfortunately, perfection has not been reached in this art, and there is always present in butter, mingled with the fats and mainly dissolved in the water, more or less of the protein, or curd, and of the sugar of milk. It is these constituents which play the mischief with butter, by starting the chemical changes leading to rancidity and decomposition, and which we consequently endeavor to reduce to the minimum.

While, therefore, in nearly all other food products the presence of protein (because of its high nutrient quality) adds to the value of the article, — if we place butter at all in the list of foods, that which has the highest nutrient value is the poorest in those qualities which go to make fine butter. We buy butter for its fat, and the more fat, and the less water and protein, the better it is as butter. In our table comparing foods, there are averages given of butter of different kinds, and, for the reasons stated, the best butter is designated by the highest figures in the column of carbohydrates, and not in the "value" column.

Examining butter in detail, it is found to be composed of very complex fats, the chemist naming eight or ten, which number he divides about equally into insoluble fatty acids and volatile fatty acids; also, in their combination with glycerine, into solid fats and fluid fats. It is not my purpose, however, to go into these details, but to call attention to the differences in butter, as it usually exists. Among the many writings upon the composition of butter none has seemed to me so ingenious and painstaking in method, or practical in conclusion, as the work of Dr. S. M. Babcock, chemist of the New York Agricultural Experiment Station at Geneva. At the annual Fat Stock and Dairy Shows in Chicago, in 1885 and 1886, and at the Bay State Agricultural Society's fair at Boston in October, 1886, I was able to secure for this gentleman samples of the premium butters of known origin — the certificate of the maker, as to method and breed of the cows giving the milk, accompanying every exhibit. Upon these Dr. Babcock pursued his investigations, and he personally obtained another set of samples of butter, with the history of each, at the New York Dairy and Cattle Show, May, 1887. Based upon his examinations of this last lot, Dr. Babcock prepared his report upon "Variation in the Composition of American Butters," which I have already mentioned, and to some parts of which I now wish to refer. The butters upon which he worked, and which gave the results presented in his tables (see Proceedings of Society for the Promotion of Agricultural Science, eighth meeting, New York City, August, 1887, page 17) were twenty-six in number, seven being from Jersey cows, seven from pure Holstein-Friesians, two from pure Guernseys, one from an Ayrshire, and nine of premium butter from mixed milk, no special breed predominating.

These samples were examined to determine the variation liable to occur in the best grades of American butters, and especially to note how far these variations might be attributed to breed and to the individuality of the cow. (Some of the samples representing each breed were from the milk of a single, registered cow.) The general determinations were noted as a matter of some interest, but attention was mainly devoted to the composition of the butter fats. The following are the average and extreme figures for these prize butters, and probably fairly represent the average composition of first-class butter in this country:

| | Water. | Fat. | Ash. | Curd. |
|---|---|---|---|---|
| Highest | 13.16 | 87.87 | 4.23 | 1.02 |
| Average | 10.82 | 86.44 | 2.14 | 0.60 |
| Lowest | 9.26 | 83.19 | 0.96 | 0.34 |

It may be noted that these butters averaged better than those in the food table, the average here being about equal to the Ayrshire butter in that table, and the poorest here being rather better than the poorest there. (It should also be stated that none of the milk and butter of these and other recent examinations by Dr. Babcock are included in the averages of the food tables previously noticed.)

The further examinations comprised determinations of the relative quantity of volatile fatty acids, of insoluble acids, by what is called the "iodine number" of the melting point, and a test devised by Dr. Babcock, of the viscosity of soap solutions made from butter. The technology of the chemical processes it is hardly desirable to describe here, but they are necessarily referred to by their peculiar names, in the following abstract from Dr. Babcock's table, and his deductions from it :

COMPARISONS OF BUTTERS FROM DIFFERENT BREEDS OF COWS.

| Breed. | Iodine. Number. | Melting. Point. Deg. Cent. | Viscosity. Number. |
|---|---|---|---|
| Jersey | 31.2 | 34.0 | 74 |
| Guernsey | 31.5 | 33.3 | 110 |
| Ayrshire | 37.8 | 33.5 | 66 |
| Holstein | 40.0 | 33.4 | 237 |
| All others | 35.6 | 33.8 | 93 |
| Average of all | 35.6 | 33.7 | 127 |

The volatile fatty acids are not included in the table, because it was found that while the individual variations within all the breeds was very great, the influence of breed did not appear in this particular.

The insoluble fatty acids were found quite constant in amount, but very variable in composition. The "iodine number" indicates the relative proportion of oleic acid and the absolute quantity of this soft fat, in the total fats of the butter. "The influence of breed upon this factor is very great, one of the most marked characteristics of Holstein butter, when compared with that of the Jersey or other breeds, being shown in its high per cent. of olein. This renders butter less firm in warm weather, although it does not materially lower the true melting point." (The quotations are from Dr. Babcock's article; he preferred to compare Holstein and Jersey butter because they showed the greatest contrast, and also because, having several samples of each, equal in number, the averages were deemed more reliable than those of the other breeds, of which he had only one or two samples.)

The melting point is expressed in degrees of the centigrade thermometer, and the record illustrates the observed fact that it requires a higher degree of temperature to melt Jersey butter than the average.

From a test not shown by the above abstract from his table, Dr. Babcock determined "that the proportion of palmitic and other fatty acids of less molecular weight than oleic and stearic, is considerably greater in Jersey than in Holstein butter."

The viscosity test indicated breed peculiarities very clearly, as well in the composition of butter from single cows, not shown by other methods. This is a very clever method of testing, and especially applicable to the detection of adulterants in butter; it is fully explained in the report of the New York Agricultural Experiment Station for 1886. In this instance, the pure Holstein butters had an average viscosity of 237, ranging from 112 to 461; the pure Jersey butters averaged 74, and ranged from 50 to 103 These numbers are relative only, but representative of a marked contrast. Dr. Babcock says: "The other conclusions in regard to the differences which exist between Jersey and Holstein butters are confirmed by the viscosities of their soap solutions" (*i. e.*, by his viscosity test).

Although these fine analytical tests may not be well understood by these brief and technical references, it seemed proper to adhere closely to the conclusions of the original report, before stating the practical deductions. Now, as to the latter: "The influence of breed of the cow upon the composition of the butter fat is no less marked than it is upon the composition of the milk, and, contrary to general acceptation (this statement is based upon other investigations) does not appear to be materially affected by the character of the food." (Dr. Babcock.) Among the effects of breed thus noted are those differences in butter which relate to its firmness, resistance to heat, texture or "grain," flavor, and general high quality, by reason of a larger proportion of the more delicate fats. In all these particulars, butter from pure Jersey milk excels, while that from other breeds follow in the order given in the last table.

In conclusion, it is hoped that facts of a reliable character have been herein presented, in sufficient number and with such reasonable distinctness, as to show the great differences which exist in dairy products — milk, cheese, and butter — the influence of breeds of cattle in causing these differences, and the consequent practical value of a study of this subject, when selecting stock for the profitable conduct of any branch of dairying.

Mr. EDWIN HOYT. Many farmers are trying to get their cows to come into milk in the winter. They have warm and well-ventilated barns, thinking they can make butter as well in the winter as in the summer, and perhaps a little better. I would like to ask Major ALVORD if there is not a difference in the returns of butter from the milk of a cow that begins to give milk in the spring, and one that begins in the fall or along the latter part of the summer?

Prof. ALVORD. There are certainly differences in milk according to the period of the milking of the cow, and one of those differences is in its churning quality. Milk varies in its churning quality, from the time the cow is fresh until she dries, and I should not recommend anybody, either from a theoretical basis or practical experience, to churn together the milk of one cow fresh in the fall and another cow fresh in the spring. But I have got beyond the point where I recommend anybody to churn the milk from one or two cows. I do not recommend the running of a churn by anybody who can possibly avoid it, who has not the milk of fifty or sixty cows. That number brings in the law of averages, and we overcome this difficulty. We think we get a better result in the churning quality of the milk by multiplying the number of cows. That is one of the great advantages which the associated system of dairying has over private dairying. The greater the number of cows whose milk or cream is sent to a factory, the greater the churning quality of the milk; that is, the more butter will the factory get per hundred pounds of milk. That is a statement, I think, which experience will bear out. It is difficult of explanation, but nevertheless I believe it is a fact that a factory will make more pounds of butter from the same amount of milk than any private person can do.

Mr. HOYT. A man came to our place, and, observing that some of our cows were farrow in the spring, he said, "You won't get any return from churning their milk." In our section farrow cows are sold for whatever price they will bring.

Mr. BOYD. I understood Prof. ALVORD to state, early in his paper, that the color of milk had no necessary relation to its quality or to the quality of the butter which is produced; am I right?

Prof. ALVORD. Pretty nearly.

Mr. BOYD. Is it not a fact that milk can be increased in color and in quality by feeding corn, carrots, and pumpkins?

Prof. ALVORD. I think the gentleman's question confounds two entirely different points — *color* and *quality*. I said that color is not necessarily a valuable quality of milk. The *quality* of milk, as an article of food, and for cheese and butter, does not depend at all upon color; but if you call your milk poor, it is for some other reason than the absence of color, I should presume.

If you come to the question of food and its influence, then I should answer that point by stating that the quality of milk can undoubtedly be improved by feeding, the effect being this: that by the better feeding we bring the particular cow or cows to a better physical condition for the production of milk. And while I am not of those who believe that the food directly results in a change of the milk, I do believe that it may so assist the cow in her general condition that whereas, when she was giving what you call poor milk, she was in a low condition, where she could not do her best, her condition is so improved by improving the food that she is at her best. But when that particular cow or those particular cows are at their best, no change of food will have any effect to change their product. Additional food will then result in injury and loss.

Mr. **Boyd.** That nearly answers the question; but I suppose most farmers understand that cows fed all winter upon hay and turnips, would give an inferior quality of milk and milk of inferior color, whereas, if we change the food we can increase the color and make more butter from the same quantity of milk.

Prof. **Alvord.** The gentleman still confounds the question of *quality* and *color*, and I repeat that his milk may be of the highest quality and absolutely destitute of color. I am talking about that specially high orange color which is peculiar to some milk and absolutely wanting in some other milk. All milk, of course, is more or less opaque, but that is irrespective of the orange-like coloring matter. That question of opaqueness is one largely dependent on the kind of food and the quantity of solid food given the animal, and, of course, may be improved by improving the feeding. The gentleman states rather a low kind of feeding for his winter diet. I should suppose his milk might be improved, if he gave his cows nothing but hay and turnips, by being fed with something else. But, as a rule, I think there can be no doubt that the milk produced in winter, on the average feed of cows in the State of Connecticut, is of better quality than the milk produced at any other season of the year. You will find that an examination of the milk produced in this State, will show that what we call the percentage of total solids and the percentage of fats are higher from the first of November to the first of March or the first of April than in the same number of months in the rest of the year, I refer to the average, throughout the State.

Hon. E. H. **Hyde.** I would like to hear the musical side of this butter question.

**Prof. Alvord.** Before Governor Hyde has that pleasure I wish he would move up near enough to those tables or charts to see the figures showing the relative standing of different breeds as milk and butter producers: 1st, the Galloway; 2d, the Bengalee; 3d, *the Devon* (laughter).

The audience were then favored with some excellent music, by Mr. and Mrs. Cornish, of Naubuc, Miss Hart, and Mrs. T. S. Gold.

**Hon. E. H. Hyde.** In this connection I would request the Secretary to read this brief report.

The Secretary read report as follows, from "Bulletin of the American Devon Cattle Club," Dec. 1, 1887:

### Full Statement of the Milch Cow Contest at the Toronto Industrial Exhibition Association in which the Devon Cow, Rose of Cobourg, achieves a remarkable victory over Five competing Jerseys.

The method of judging was as follows: Eight points for each pound of dry milk solids, thirty points per pound of butter fat per day, one point for each twenty days after calving, and one point for every twenty days of gestation.

First Prize — Samuel Harper, Cobourg, Ontario, Devon Cow Rose of Cobourg.

| | |
|---|---|
| Milk per day, 37 lbs. Solids, per cent., 13.93. | |
| Weight of solids, 5.154 lbs. x 8, . . . | 41.232 |
| Fat, per cent., 4.352. | |
| Weight of butter fat, 1,611 lbs. x 30, . . . | 48.330 |
| Days calved, 352 divided by 20, . . . | 17.600 |
| Days of gestation, 98 divided by 20, . . . | 4.900 |
| | 112.062 |

**Mr. Phelps.** I would like to ask the speaker one question. He spoke of Prof. Babcock's experiments at the New York Experiment Station as indicating a great deal of variation in the quality of the fats of animals of the same breed; and he also said, I believe, it was affirmed by Dr. Goesmann the other day that feed did not seem to affect the composition of fats.

Now I would like to know if the Professor can tell us what it is that affects the volatile fats in milk. He will very likely remember that in the course of a lecture given at Amherst last winter an account was given of a little experiment that was tried in feeding an animal exclusively on highly nitrogenous food, and it was found that the butter could not be hardened. Now, was the trouble in that case that the amount of volatile fats was increased, or was something else the trouble? If the Professor can tell us I would like to know what it is that affects the amount or percentage of volatile fats in the butter?

Prof. **Alvord.** I certainly cannot undertake to answer that question definitely, but with our present knowledge, it seems to me that we must believe that the matter of the volatile fats is, so to speak, one of the individual peculiarities of the cow, and it is only when it happens that a number of cows in like peculiarity in this respect are brought together, that we distinguish any very great difference in the average product in this particular. I should say that it has relation to the general make-up of the animal, rather than to our particular care or feeding.

Mr. **Hawley.** The Professor stated that the color of the butter was produced by pigments secreted in the cow. As the color of butter adds largely to its selling value I would like to ask if we can in any way increase the secretion of the pigments in a cow that is somewhat deficient in that respect so as to add to the selling value of the butter?

Prof. **Alvord.** I do not believe you can materially change this characteristic of any particular cow. Of course there are certain foods that carry in themselves some degree of coloring matter which can be fed to the cow, but that is an indirect and expensive way of doing it, and I am not one of those who make any serious objection to doing it in a cheaper way and directly coloring the butter. There are various preparations by which butter can be colored to any degree which is desired, and I do not see any objection to doing it, because it is merely coloring, as salt is flavoring. .We have no use for salt in butter except to make it more palatable to us, and we have no use for color in butter except to make it more pleasing to the eye; and while I prefer a cow that will do this for me, if she is not doing it, I do not hesitate to use coloring matter in making the butter.

Mr. **Waters.** I would like to ask the Professor if he has known of any instance where physicians in recommending milk for infants have preferred the milk from one breed in preference to any other breed?

Prof. **Alvord.** Certainly; I have known of a great many such instances. I alluded to the fact in my paper that there was high medical authority for the preference of Ayrshire milk over that of other breeds as food for infants and invalids. I think medical authorities generally place next in the list the milk of the various breeds of Dutch cattle, because of the finer comminutions of the particles of fat and their better distribution throughout the milk, and also because there is less of fat. Physicians all object, I believe, to milk being too rich in fat in such cases. They therefore object to the milk of the Channel Islands cattle, and to the milk of any special butter breed for young children, as being too rich in fats.

Mr. W. R. **Sessions**, Secretary of the Massachusetts State Board of Agriculture. I would like to ask the Professor if we are to understand that the amount of food we feed the cow will make no difference in the amount of butter unless it increases the quantity of milk?

Prof. **Alvord.** Partly, but not wholly. You might infer that from what I said, though I do not want to be understood as saying so directly. In the case of a well-fed cow, I do not believe additional food will increase butter without increasing the quantity of milk; but I think that changing the food may make such a change in the physical condition of the cow as will cause her to produce a richer article of milk. If it is true, as we now generally believe it is, that the fat of the milk is a part of the cow herself, and therefore has its limits, then it is the condition of the cow that determines the quantity of this fat which she throws off from her system through her milk, and that condition of the system may be unquestionably changed by changing the food, and perhaps without changing the quantity of the milk.

Mr. **Fenn.** I would like to ask the Professor if the cows from which those samples were taken were fed the same rations during the time that the milk was being gathered?

Prof. **Alvord.** I wish we had the history of every cow from which any of that milk was taken and an accurate statement of all the food she had. But we must make progress one step at a time. We have got so far now that we can get averages of milk from distinct breeds, a thing which we could not have done ten years ago; but I have simply taken in these three samples, *averages* of milk from a good many hundred cows, and they had, consequently, the average food of cows; but I cannot put that average food into figures for you. I do not know anything about it. It is fair to presume that the number of animals and the general sources from which the averages were made up, were so large that the animals of one lot were treated just about like the animals of the other lot. That is all I can say. There are imperfections all the way through.

The **Chairman.** Gentlemen, it gives me pleasure to inform you that our old and long-tried friend Dr. Sturtevant, from the New York Experiment Station, is present here, and the doctor always comes with something of value to impart to the people. He has made a specialty of the subject of the lecture with which the Major has favored us, and I know you will be glad to hear from the Doctor (applause).

Dr. E. L. **Sturtevant.** I never can refuse anything to a Connecticut audience, where I have appeared so many times, and I have some special interest in this subject which has been talked of to-day. If it will add anything to the value of Major Alvord's paper I will say I thoroughly agree with him in his conclusions. I think that he is correct according to the very best of our present knowledge.

The subject which appears to interest the audience just now has reference to feeding for butter. Some years ago I made the assertion that breed is superior to feed, and while my remarks were never affected in the slightest degree by what I may have said previously, because it frequently happens that increased information changes my opinion so that I may talk differently to-day from what I talked yesterday, yet six years of experimental experience leads me to the conclusion that we have got to look to breed for much of the changes which we would produce. You cannot feed an Ayrshire cow, or, at least, I have never been able to, in such a way as to get her butter the color of Jersey butter; nor, on the other hand, can you change Jersey butter into the color of Ayrshire butter, although you may have either butters darker or lighter in color. I think that that very fact itself ought to lead us to the consideration of this question of breed, and to suggest whether it is not the cheapest way to improve or to get the qualities that we desire by going where those qualities are hereditary and where we can depend upon them.

I want to make a seemingly radical assertion, and that is, that in those six years' experience, with the most thorough and careful experiments, we are unable to say that we have changed the composition of butter by any change in the character of the food. I do not say it cannot be done, I only say that we have never been able to do it. Contrary to the general opinion, it seems to be more a question of nutrition than of the character of the food. If you put albuminoid into an animal to the extent of her capacity to assimilate you will then get the largest quantity of produce in the form of milk solids, which, as the Major has so well said, constitute the value of the product. And then that question is complicated a little by the question of breed, and condition of the animal. In farming we have got to look at things from a good many different sides; so I do not think that we can say that we must simply put into the cow all the albumen possible in order to get the largest results, for a cow that is gaining in weight is apt to yield less milk than one which is losing in weight. This matter is, however, so complicated that when a person tells you his experience on this subject and omits to note whether his animals are gaining or losing weight during the time of trial, you have got to question the accuracy of his conclusion, although you may accept the truthfulness of the fact that he narrates.

This whole question is one of experiment that has got to be worked out at experimental stations, and it is wise for the farmer to take heed to the testimony coming from accurate experiment. But the experiment station, until it works farther, cannot afford to come to a conclusion, but must simply report progress and say whether or not the direction of that progress is in conformity with the best opinion of the best practice. When it is, it can be depended upon. I think that covers the point which I wished to bring out. (Applause).

The CHAIRMAN. Do you wish to ask Dr. Sturtevant any question? He will bear squeezing pretty thoroughly.

Mr. HAWLEY. This is a subject which is vital to us. I would like to ask Dr. Sturtevant if, upon feeding a cow upon hay and grain, we should change to some cheaper and less nutritious food, and yet keep her at the same weight, the same amount of flesh, whether she would not reduce the amount of butter produced?

Dr. STURTEVANT. The question is a little self-contradictory. By decreasing the nutritive value of the food how can you prevent the cow from losing flesh?

Mr. HAWLEY. We might increase the quantity of less nutritious food and in doing so reduce the cost, and yet still keep the cow up to the same average standard. I have always felt that improving the quality of the food told upon the butter in the churn.

Dr. STURTEVANT. If the testimony derived from experiments is reliable for general conclusions, — I do not dare to generalize myself any more than this, — so far as that testimony goes it appears to be a question of nutrition, and if you change the food to a cheaper form and yet increase the amount of albuminous food, the probability is that you will get a larger return in the milk. That is, under normal circumstances I should say you would.

Mr. **Slater**. The first speaker claimed squarely that the quality of the feed did not affect the quality of the butter. The doctor says that the condition of the animal causes a change in the richness of the butter, and the condition of the animal can be controlled by the feed.

Dr. **Sturtevant**. I did not intend to give such a mixed-up impression. (Applause.) I did not say that I differed from the statement that Major Alvord has made, nor from what I think will be the testimony of farmers when they get at the real causes of the results which they obtain. But in order to carry this theory into practice we have to meet such complex conditions that it becomes very dangerous for a man to tell you to do a thing and then tell you how to do it. I can illustrate that by a little accidental experiment. You noticed that the Major gave credit to the New York Agricultural Station for having recorded the largest and smallest per cent. of butter-fat. Now, the history of that matter I think will interest you a little. A cow had been gaining flesh very rapidly, and had become very fat, and then, through a little indigestion, she lost her appetite, and ate little or nothing. She therefore had a period of what I may call starvation. She lost weight. The first effect of that starvation was to increase the butter in the milk until it ran up to the enormous amount of 12.53 per cent. Then, when starvation got well established, the butter in her milk ran down to a very low point, two per cent. and a fraction. There was a cow standing in the stable, eating nothing, and the result was the butter ran up to twelve per cent., and then ran down to two per cent., while the average yield of butter from the milk of that same cow was five per cent. This circumstance started me thinking, and so I went into the business of trying some experiments of starving cows. When I say "starving," I mean giving them a less ration than is required to maintain live weight. When I came to look over the figures of the results I found that when a cow was losing weight through insufficient nutrition the milk was getting higher in butter percentage, and from that I inferred that the fat of the body was more easily carried into the milk than was the fat from the ration. We have also taken a cow (Mr. Babcock had the experiment under his special charge) and fed her the largest quantity of linseed meal that she could be forced to eat without producing any change in the composition of the milk. In other words, when a cow is giving the maximum product of the individual, — that is, if her maximum under proper treatment is five per cent., — I know of no way except by starvation by which you can increase even temporarily that percentage, and then only for a few days, when it is followed by a reactionary loss. Breed seems to determine rather than food, I say; but in saying that I wish you to understand that I simply mean that the results of experiments look in that direction, because the question is not as yet fully decided. It may be that I am wrong.

Mr. PLATT of New Britain. I would like to ask if feeding cotton-seed meal to milch cows to any extent is to be recommended?

Prof. ALVORD. I will volunteer on that point. I do it in practice and believe it is a good thing to do, especially for the production of milk for use as food and for sale, because cotton-seed meal is certainly a stimulant and serves to increase the milk production. But there is a limit to which it can be fed and the cow must be watched in order not to exceed that limit. Cows differ very greatly in their capacity for the assimilation of cotton-seed meal. I believe that, for some cause or other, a cow that gets too much cotton-seed meal produces butter differing in some respects from, and less desirable, than the butter she produces with less cotton-seed meal or without any. I buy a load of cotton-seed meal every year, and feed just as much as I dare to my cows, not so much for its butter value as for its manurial value, and when spring comes, what has not gone through the cows goes on to the land just the same as if it had. I use just as much as I can as food for my cows, but I put just about the same every year on the land.

Mr. PLATT. I would like to ask the Professor whether he considers cotton-seed meal as easily digested as other food and whether the animals assimilate it as readily?

Prof. ALVORD. I think not, and that is the reason of the care I take in feeding it. Animals differ in that respect just as we do.

Mr. PRATT. How much will it do to feed?

Prof. ALVORD. Try your cow and find out. Your cow may be different from mine. I have seldom had a dairy cow that I could satisfy myself it was safe to feed more than three, or, at the outside, four pounds a day for any length of time. As a rule, I prefer to keep it down to two or three pounds. Of course, you will occasionally come across animals that will assimilate a good deal more than that; but, as a general rule, I do not feel warranted in giving more than four pounds a day, at the outside.

QUESTION. I would like to inquire how you find butter affected by feeding cotton-seed meal?

Prof. ALVORD. I have never been able to fully put the two things together or make one account for the other, but I have observed the fact, that at times when we have been feeding the most cotton-seed meal the butter lacked texture, and did not seem to have as great resistance to a high temperature, as when the cotton-seed meal was omitted. It was of a softer character. There seemed to be a greater proportion of the softer fats in the butter. At other times, when the same quantity of cotton-seed meal has been fed, the butter did not have that character. Consequently, as I have said, I am not prepared absolutely to charge the cotton-seed meal as the cause, but that has been my observation and that is one of the reasons why I have limited its feeding. More particularly, however, it is the effect upon the general physical condition of the cow.

QUESTION. Do you mix other food with the cotton-seed meal?

Prof. ALVORD. Yes. I never fed a cow for any length of time on cotton-seed meal alone.

QUESTION. What mixture would you recommend for cows?

Prof. ALVORD. That is a pretty long story. I like to give my cows a liberal bill-of-fare in the way of variety. Cotton-seed meal comes in as part of it, most of the time. I feed a little cotton-seed meal usually through the summer, when I am perhaps feeding very little other grain, but in winter the cotton-seed meal furnishes largely the nitrogenous portion of the ration. I would add to it wheat bran, and feeds of a similar class for the sake of bulk and digestion. I am not particular about any other grains if the long forage is of good quality. If the hay is poor I supplement with corn meal, and if feeding cotton-seed meal, I much prefer corn-and-cob meal to go with it; or, corn bran, when that can be obtained.

Mr. **Phelps**. I would like to ask the Major if he thinks the food does not have any effect upon the chemical quality of the milk, that is, in increasing the percentage of fat, or if, in connection with this, and in addition to it, he means that it does not have any effect upon the flavor of the products? There are a great many farmers in the hall who have heard what he has said and who, it seems to me, would draw the conclusion that the feed has no effect on the quality of the butter or the flavor. Now, I think by feeding turnips, cabbages, and various things of that nature you will affect the quality of the milk, and of the butter by affecting the flavor.

Prof. **Alvord**. In the matter of flavor, I believe we have to look for the effect of the essential oils, the volatile oils, the flavoring oils, which are found in many vegetable products, and which are prominent, for example, in onions and cabbages. In those cases where we have a vegetable that is highly charged with a strong, pungent essential oil, I am inclined to think that odor does find its way through the cow to her milk, as it certainly does to the flesh of the animal, sooner or later, and oftentimes directly. There are familiar instances of beef cattle, which have been affected by the feeding of onions and cabbages. But after we get beyond a limited list of those articles which have a large proportion of these volatile oils, I think our feeds are pretty safe, so far as their flavor going through the animal is concerned; but there are lots of them that will flavor the stable and the air that the cow breathes, and in which we milk, and that affect the milk of the cow while passing to the pail or while in it. We charge it to the cow and to her milk directly, when we ought to lay it to the air and the general surroundings.

Mr. Sessions. There is an old saying that figures won't lie, and I suppose that experiments by scientific men are to be depended upon, but they seem in this case to be contrary to what have been assumed to be facts by practical men in years past. I know men who are in the habit of allowing their cows to eat all the salt they possibly can so that they may drink more water and give more milk. I know men, and prosperous men, too, who feed distillery slops to their cows, and claim that they get more milk from them than they can in any other way, and their patrons do not complain of the milk. We hear of the distillery milk of New York being of very poor quality. It seems to me it makes no difference that those cows are fed on distillery slops if, as you say, the feed does not affect the quality of the milk. That is the way it seems to me, a layman. It seems to me a strange condition of facts, and I would like to have the Major hit just that, if he can.

Dr. Sturtevant. I think Mr. Sessions has entirely misapprehended the whole nature of that discussion which took place a year ago and extended over a period of several weeks in regard to the character of distillery milk, the result of which was that it was demonstrated that the injury that comes from using the milk of cows fed with distillery slops comes from the sanitary condition under which the cattle are kept; and until you can show a case where the milk of cows kept under good sanitary conditions and fed with distillery slops has done injury, we must admit that as food, when properly fed, it may be used without injurious results. Many years ago, before Health Commissions were as plenty as they are now, the city of Glasgow in Scotland was commended for the excellent quality of its milk supply. I attempted in 1869 to visit, and I think I did visit, every dairy herd in that region tributary to the city of Glasgow, and I did not see a single cow in all those herds that was not fed brewer's draff and distillery wash, but under good sanitary conditions. They were standing in clean barns, had good food in addition to this distillery stuff, and the milk not only showed well, tasted well, appeared well, but was pronounced good by all who came in contact with it; and there was never a suspicion that any injury resulted from feeding this brewers' draff and distillery stuff which was hauled out every day at one penny a peck. If any of you have seen the pictures of the distillery stables which appeared some years ago in our illustrated papers you will at once understand that the sanitary condition of those distillery-fed cows probably had more to do with the quality of the milk than the character of the food used.

Mr. SESSIONS. The gentleman has misrepresented my position in that respect. What I said had no reference to the way the cattle were kept, but simply to the effect of food upon the character and quality of the milk. If a certain kind of food will produce more milk, will it produce more butter? As I understand the scientific gentlemen who have presented their views here to-day, the food has no effect upon the quality of the milk. That is the conclusion to which I am drawn by this discussion. The point I want to get at is whether we shall feed simply to produce the most milk, or whether the quality of the food makes a difference in the quality of the milk? That is the practical point.

Dr. STURTEVANT. That may be the gentleman's point, but the point that Major Alvord and I have spoken of from the beginning, is the influence of food upon the composition of milk. I have carefully avoided this other point, which is attended with so many complications that I wanted to keep the discussion right where it started, upon the percentage of composition of milk. My remarks must be interpreted as referring to that. I thought I was very careful to have that understood. The questions are all interesting in themselves, but they bring up an entirely new and distinct line of discussion.

Col. **Warner.** I am getting into the fog deeper than my friend Sessions. I don't know what to believe. I don't know but science will tell us we can keep our cows on air, but I can hardly believe it. I would like to ask this question. I will take a cow in a given physical condition,—she is giving a certain quantity of milk; now, can I increase her yield and at the same time keep her in her present condition by feed?

Prof. **Alvord.** In the first place, if Col. Warner will try the experiment, if he shall succeed in keeping a cow in exactly the same condition for any length of time, he will teach a valuable lesson to us all.

Col. **Warner.** I can keep them in very nearly the same physical condition, and I can so feed them that I will increase the quantity of milk one-third. That is my experience.

Prof. **Alvord.** We are raising, perhaps, a side issue, but still it is a very difficult matter to keep a cow in an even condition physically. I have yet to see a set of experiments in weighing any animal giving milk or any animal that was intended to be kept in store condition, where the weights day by day and week by week were at all even, and consequently it was impossible to tell whether the milk came from the body of the cow or from the food she ate. It is not a likely condition of things. I am obliged to deny, from the facts on record, that it is possible to keep a herd of cattle in absolutely like condition for any length of time. That is one of the reasons why we are so much in the dark.

Col. **Warner.** Provided we do keep the cow in the same condition?

Prof. **Alvord.** I say that is an absolute impossibility, so far as the record goes. There is no record of any single cow, much less a herd, being kept for a month in exactly the same condition. But assuming maintenance in the same condition, I admit at once that it is possible to so feed an animal as to increase or decrease the quantity of milk; but when she has reached the limit of her milk production, then it is not possible to so change her food as to increase her product. It is possible, however, to reduce it. But I think when my paper is examined, no such construction can possibly be placed upon it as has been intimated by some of the remarks which have been made here and by some of the questions asked, namely, that I deny any effect of food upon the animal or the animal product. The point that I intended to make (although I do not seem to have succeeded very well) was, that *the main differences in milk result from the breed of the animal rather than from the food.* I did not intend to go into a discussion of foods and feeding, which opens an entirely different field. I would willingly enter that field at the proper time, but would now rather stick a little closer to the line of work laid out for this particular occasion.

Mr. Webb. I have heard this matter discussed at several meetings, in regard to changing the feed of a cow in good healthy condition in order to increase the quantity of milk and at the same time the proportionate quantity of butter to the quantity of milk, and I have always understood in the discussion of this question that the assertion was made from scientific research that it was almost impossible to do it; but perhaps that was not the general understanding. But there are other questions which come in which are very important in regard to this dairy business. The past season was one peculiarly favorable for the production of milk, until about the first of November, when our cows were taken from pasture. I mowed more rowen this year than I ever did before, and when I took my cows from pasture I fed them on rowen, good hay, and dry feed. They dropped off in one week over 125 quarts. What was the cause of it? how shall we explain it? and what shall we do to avoid it? I do not know. There are a great many such cases that we have got to meet, and science cannot place us on the right road and direct us how to keep up the quantity of milk at the time of this change. Therefore, we must do the next best thing and avail ourselves of anything that we think will enable us to meet and overcome the difficulties, if our circumstances are such as to demand it.

Here is another question which I consider very important in the discussion of this matter. The waste of corn-fodder in the State of Connecticut by pure neglect amounts to millions. While we are suffering that loss, Illinois butter is selling two cents a pound higher in New Haven than the product of any dairy or any butter factory in this State. Now, have we not better water, have we not sweeter and better grasses, than the prairie grasses? Why is it that we find this thing as it is? I have a fixed faith that the people of Connecticut can raise more fodder, keep their cows in better condition, and place in market a better product, either of butter, of cheese, or of milk, by raising a great deal more corn and adopting the Western method of running it through a machine with the ears on and feeding it, than they can in any other way. I have seen that assigned as the reason why the butter of northern Illinois was better than ours. Now, we can do it. We can double the number of milch cows in the State of Connecticut in three years by adopting that plan.

Dr. STURTEVANT. I am very glad to hear Mr. Webb make these remarks, because it gives me an opportunity to bring a little of my recent work before the audience. You farmers probably assume that when you have rowen of equally good appearance it is always of equal feeding value, when cut at the proper time. In some investigations which have not yet seen print we found that hay cut from the same place last year and this year, at precisely the same stage of growth, analyzed by the same chemists, in the same manner, differed very widely in nutritive value. The albuminoids in last year's crop ran 4.69 per cent.; this year it ran 8.12 per cent. We also found when we applied the process of artificial digestion a similar difference, the one crop being more digestible than the other. This year in Geneva was a year of extraordinary drought; last year was a moist year. I have just spoken to your secretary, Mr. Gold, and he tells me that here in Connecticut you have had a wet season, and in all probability, judging from that one experiment of which Mr. Webb speaks, if he had sent his rowen to the Connecticut Experiment Station to be analyzed he would have found it deficient in food value, and that would probably account for its falling behind his expectations, and account for the falling off in the milk. He very likely did not feed his cows the proper nutritive ratio.

Mr. **Webb.** I have ordinarily soiled my cows with fodder-corn, but this year I let my fodder-corn stand, cut the rowen and fed it green to my cows instead of feeding fodder, and the change to dry rowen produced this falling off in the milk.

Mr. **Gold.** I must beg the indulgence of the audience for interrupting this interesting discussion just here, but as a farmer, a Connecticut farmer, and familiar with the statement of scientific men that by feeding you do not change the quality of the milk, that is, its amount of solids or fats, I have tried to reconcile that statement with the universal testimony of all the farmers in the State, and I have come to the conclusion that the only method by which it can be reconciled is that these men when they talk to us speak of what is called a sufficient ration, the animal being in a perfect state of health — at its "best." They speak of the physical condition of the animal, and so on. Now, are we not, as farmers, as a rule, furnishing our stock with an insufficient ration, so that their physical health is not at its highest point, and hence when we change to better feed we are approaching nearer to a perfect, complete ration? May not our conclusions and theirs both be accepted and explained in this way?

There is one fact which has not been mentioned here that has a bearing on this question. If any one of you who sends milk to New York will leave off your corn meal and put buckwheat bran in its place, it will not be long before you will hear from the other end of the route, 150 miles away, about the quality of your milk. (Applause.) It has not changed in its odor, it is made in the same stable, the conditions are the same in every other respect, but if you feed that article to your dairy cows you will hear from it. When we start with cows in a healthy condition and feed a perfect ration, we start under as nearly perfect conditions as can be obtained, and when we add corn meal or other products we may get no better milk; but when we start with cows fed with straw and nothing but straw, and add a small quantity of corn meal to the ration, I think the universal evidence of the farmers of the State will be that the quality of that milk is affected by the change in the ration. (Applause.)

Prof. JOHNSON. What do you mean by "quality?" per cent. of cream, per cent. of fat, per cent. of casein, or per cent. of flavor?

Secretary GOLD. We are confident that the constituent elements of milk which create its quality can be improved by changing from a diet of straw to a better diet.

Mr. SEDGWICK. I want to ask one of the professors a single question. My understanding of the lecture is that the quality of milk is influenced, not by the feed, but more particularly by the breed of cattle. I want to relate a little experiment and ask a question about it. Some years ago, when I was in the milk business more extensively than I am now, I took a stable of twelve cows that were being fed a good fair ration of grain and hay and I began to give them warm water. I mixed their grain with warm water, and all the drink that those cattle took for a given length of time was warm water. In a week's time I had increased the flow of those twelve cows forty quarts of milk. Now I would like to ask, the flow of milk increasing in that way, with no extra amount of hay or grain, if that was not the best investment in water that I could possibly make? In other words, according to the statement of these gentlemen, the quality of milk made from that water was just as good, that is, the constituents of the milk were just as good, as if it had been made from grain or hay. Am I right in my inference?

Prof. JOHNSON. Of course the milk was made from the grain and hay. The warmth of the water saved the animal the necessity of consuming grain and hay to keep itself comfortable. The experiments which are made, for example, in the Experiment Station, in order to be of any value scientifically or practically, have to provide for uniformity of temperature. That is an essential condition. Mr. Sedgwick has simply saved for the animals the hay and grain which would be necessary to keep them warm. The milk which he got had no different composition from what it had previously to his use of warm water. If he had used warm air he would have got the same result as from using warm water.

Prof. **Alvord.** That particular point cannot be answered further, certainly, but I wish to refer back a moment to Secretary Gold's suggestion of the buckwheat bran. It seems to me that that is perfectly reconcilable with any position which I have taken on this subject. If a cow having a good ration and giving good milk is changed to a diet of straw and buckwheat bran, the cry, if listened to carefully, would be found to come from the cow before it came from the consumer of her milk; and that was not an example of the buckwheat bran having a direct effect upon the milk of the cow, but it was the result of depriving the cow of the food necessary to sustain her life and thus impairing her capacity for the making of milk. And hence (to go back to the general point), permit me to thus restate my proposition: If a cow of any breed is not doing her best as a dairy cow, it is in entire accord with all our practical experience to so change her food and care as to bring her up to her best; but when we get that cow to her best there is no known method of feeding or care that will make her do any better. But breed that cow so as to make her calf a better dairy animal than the cow herself and then the same food and the same care which the dam received will give better results. Hence, it is the breed first and the care afterwards. And we must all admit and never forget that it is the greatest possibility of the animal or animals we are handling that we should strive for as feeders and keepers. I only claim that when that limit is reached, more food is wasted food, and that the limit can be more extended by breeding than by feeding.

Mr. **Hawley.** For a number of years I resided in a milk-producing section sending its milk to Boston. I have been very much interested in the law recently made and carried out in relation to the supply of milk for Boston. It is several years since I read it, and I may not be correct in my remembrance of its provisions; the Secretary of the State Board of Agriculture of Massachusetts will please correct me if I make any mistake. I think Dr. Babcock, the chemist employed by the city, bought in the open market, samples of milk; he analyzed those samples, and if they fell below the percentage of solids required by that law the producer of that milk was notified that the quality of that milk was below the requirements of the law and he must bring it up by feeding corn meal to his animals to produce milk with a higher percentage of solids. Am I right?

Mr. SESSIONS. I think that the notification is that he must bring it up, and the impression has always been that corn meal would do it. I do not know that there is any requirement of that character, but it has always been the impression throughout the community that poor feed made poor milk and rich feed made rich milk. Now, if the feed does not produce any effect upon the quality of the milk, why should not the quality of milk be just as good produced from buckwheat bran as anything else? Perhaps I am obtuse, but the result of the teaching we have had here seems to me to be that. I appreciate the value of science, it will bring us up to a higher plane by-and by, but do bring your science down to us so that we can step along with you. (Applause.)

Mr. WEBB. Will not poor feed make poor beef as well as poor milk?

Prof. JOHNSON. I think that practice and science are not so far apart as is often supposed when they understand each other. The trouble is that when we talk about the *quality* of milk some of us are thinking of one set of qualities and some are thinking of another. By *quality* of milk Major Alvord means the proportion of nutritious elements in the milk. The color, smell, and much that enters into the commercial estimate of milk, are matters which we are not talking about here. Major Alvord uses the word "quality" in a restricted sense; you are using it in its general sense. Now let me ask this question: How do we practically judge of the quality of milk? We judge of it in the same way in which our ancestors have done since the days of Adam. It is only within the last fifty or sixty years that we have had the means of making such comparisons of the real quality of milk as are on these charts. Mr. Gold has told us that the quality of milk is affected by the food of the animal. I asked him what he meant by "quality." He said the constituents, etc., etc. Now, what is the evidence that his buckwheat-bran milk contained any less percentage of butter, casein, or sugar than the milk which he got before he fed buckwheat bran? We are justified, I should say, in believing that the milk from the cows fed with buckwheat bran was just as good as other milk, so far as its nutritive qualities were concerned, until the evidence of chemical analysis gives its verdict to the contrary. The richest milk we have, that of the Jerseys, is too rich for invalids and for children, as experience shows. We find the milk of Ayrshire and Holstein cows is the best for certain purposes. We should, then, hold to the definition of "quality" as it has been laid down by Major Alvord, in discussing the conclusions he has drawn. To show how fallacious the ordinary means of judging of the quality of milk are, let me give an instance out of my own personal experience. Some years ago, my wife said to me, "The milk we are getting is very watery and poor, and little or no cream rises on it; we must change the milkman." I analyzed that milk and found that it had over twelve per cent. of solids, with a due proportion of fat, and accordingly was good, honest milk. What was the difficulty with it? It came from one of these breeds that are adapted to produce milk for town consumption. It was of the sort that does not cream readily, and it was always considerably agitated by some miles transportation before delivery. My wife, accustomed to country milk, under country handling, judged from the thinness of the cream that the milk was poor. Now, a deficiency of cream is no necessary sign that the nutritive quality of the milk is inferior. Cream is a delusion and a snare when you measure it by a gauge. It is not the number of inches of cream that will tell you the amount of butter. To get cream from milk it must stand quietly and at a proper temperature, but this milk, when delivered, was set in an ice-box.

We have, I believe, a scientific basis for the statement that, in general, food does not change the quality of milk. That there may be exceptions to this statement cannot be denied, but as yet exceptions do not appear to be well substantiated, and if a few exceptions should be demonstrated to occur, they will not invalidate the *general* truth of this statement.

QUESTION. What would you have as the milk standard?

Prof. JOHNSON. I should say eleven and one-half of solids.

Mr. ———. The Massachusetts law says thirteen per cent.

Prof. JOHNSON. I think that is too high. Honest milk will not always come up to twelve per cent. of solids. The legal standard is not necessarily a correct one.

Prof. ATWATER. It occurs to me that possibly a word of explanation is necessary. Major Alvord has spoken of the quality of milk, and Professor Johnson has called special attention to what is to be understood by that, namely, the relation of the different ingredients to each other. If there were time some account might be given of a series of experiments made in several experiment stations, at an expense of thousands and thousands of dollars, running through, I believe, twenty years. In one place in which this particular subject has been studied, with all the advantages of the combination of the best science and the best practice, the result of that accurate study, feeding cow after cow, half a dozen or more at a time,—feeding them under all varieties of condition,—different breeds of cows, different kinds of food, and all that sort of thing,—the result of that, I say, substantiates Major Alvord's statement. But that did not tell the whole story as the story is being talked of here. We want to have you distinguish, in the first place, between the proportion of the different ingredients of the milk solids, and, in the second place, the proportion of total milk solids to total milk. I do not think it is safe now to lay down a general law, but there are experiments which tend to show that by changing the feed you may change the proportion of total milk solids to total milk, and you may change the percentage of those solids in the milk. Or, to put it in another way, there are two ways of watering milk. One is to take the water from a pump and put it into the milk ; the other is, to give the cow the water in the first place. Now, I say there have been some experiments which have illustrated this. It is very easy to see, I take it, how putting water into milk would produce watery milk, and certainly there are well-attested cases in the experiment stations where the total milk product was increased by increasing the water, but there has been no increase in the amount of solids. Now, Mr. Sedgwick says that he warmed the water that he gave to his cows. That is to say, instead of burning the hay and the grain to warm his cows he burned wood and coal to warm the water, which were cheaper than hay and grain. I can imagine that his milk might have been somewhat more watery if his cows had more watery feed. I can imagine that the lactometer would have shown more water. It seems to me that the explanation I have given may perhaps reconcile the different views.

Mr. CHEEVER. I simply desire to add a word of possible explanation which may throw some light on this question. A few weeks ago I was asked by the former Secretary of the Massachusetts Board of Agriculture, Charles L. Flint, to assist him a little in revising his work on " Milch Cows and Dairy Farming," which is certainly an acknowledged standard dairy volume in New England among the farmers who are practically feeding and milking cows, and I have been reading that volume to see whether there was anything that I could suggest by way of changes in the new edition, and I came to this very point that has been under discussion this afternoon. The statement of that book is as plain as the English language can make it, by the author and the authorities quoted by the author, that farmers can by a selection of feed make milk to order; that cheesemen can make cheesey milk to order by a selection of feed; that the butter-maker with equal facility, by a selection of feed, can make milk with a large per cent. of butter. In other words, they can make either butter milk or cheese milk by a selection of feed. That struck me as not being quite orthodox according to the present-day teaching, and I have been investigating and studying on that point. I am very glad it has been brought up here, and I think that with such statements in our literature, which is the source from which many of us have gained our supposed knowledge, it is well to stop occasionally and ask if all this is actually so. I cannot help taking the statement of the chemist and the experimenters in this matter. I can see, how feeders like myself, who are judging largely by their own experience, may very readily accept that old doctrine that they can vary the character of the milk, make it either butter milk or cheese milk, at will, because few of our cows are fully fed and fully watered, constantly and continuously, up to the maximum. We do not do it in hot, dry weather, we do not do it in cold weather; in fact, we do not do it much at any time; and a half-fed cow or a starved cow can be changed very soon in regard to her milking qualities. There is no doubt of that at all.

Mr. Webb. I think a distinction ought to be made in this discussion. I will make the assertion that we can very easily change the commercial value of milk by feed and care, although we may be unable to change the chemical constituents of it. By failing to take proper care of our cows we can adulterate their milk and we can make it unmerchantable, without any bad flavor. I will state a little circumstance that occurred some ten or fifteen years ago. I had a turnip crop of several thousand bushels; I got them out with little care with regard to dirt, and fed them to my cows that season until I found, when I held up a glass of milk, that it was actually roily with dirt. I was compelled to fix a tank and wash all the turnips I fed that winter. Now, as I say, we want to make a distinction here. When the chemists come here and tell us about the value of milk, they give us its constituents, that is, its chemical value; but we want to understand that while they may be, to a certain degree, invariable, the commercial value of milk is very easily impaired by neglect or improper feed.

Adjourned to evening.

## EVENING SESSION.

The meeting was called to order at 7.30, Vice-President DAY in the Chair, and the exercises of the evening were opened by a song from the quartette, which was loudly applauded.

The CHAIRMAN. We are to have this evening a paper upon "Experiments with Fertilizers," from a gentleman who has paid more attention to experiments with fertilizers in the field, perhaps, than any other man in Connecticut, and who is able to give you an accurate statement of the experiments which he has made. I introduce to you Mr. William I. Bartholomew from Windham County.

## EXPERIMENTS WITH FERTILIZERS.

### W. I. BARTHOLOMEW.

The time has passed when an intelligent body of Connecticut farmers need be informed that sufficient plant-food may be added to our fields in the form of commercial fertilizers, to replace that which has been taken from them in one or a succession of crops; and to cite instances where it has been successfully done, for a long term of years, without diminution of tho crops, would be unduly taxing your patience. It is generally admitted also that with soils of sufficient fertility to be worthy of cultivation, but three elements need be added for this purpose, viz.: Nitrogen, phosphoric acid, and potash, and upon the proper and economical use of these, depends to a great extent the art of fertilization. The amount of these furnished by the annual yield of the soil, and by the excess remaining in it from former years, is not usually sufficient, in fields for a long time annually cropped, to give profitable returns for cultivation, and hence has arisen the necessity of increasing the amount of nourishment, in order to obtain a satisfactory harvest. In former years, this supply of plant-food on most farms, remote from cities or large villages, was derived almost all from the farm-yards, but more recently it is conveniently obtained wholly from other sources.

These are principally commercial fertilizers, and their values, as well as the values of manures, are mainly based upon the amount and condition of the nitrogen, phosphoric acid, and potash, which they contain.

We are frequently asked which is the better for practical use, manure or fertilizers ? Each of these seem to possess some desirable qualities not to be found in the other, and most of our well-informed farmers make use of both, and both will continue to be in demand. The farmer should consider manure a valuable product of his farm, containing a large amount of plant-food, just as he considers his hay and grain valuable products, for the amount of animal-food furnished by them. As different plants require the elements of plant-food in different proportions, and the amount contained in the soil of one field is often unlike that of another, it cannot be expected that any rule for the compounding of these fertilizers, or any particular kind of manure will be the best in all cases, but the real value to the farmer is estimated by its results. The great questions in fertilization are : In what proportions are these elements needed for each crop; what parts may be furnished by the soil; and in what form and manner can the deficiency be best supplied ?

A few years ago it was believed that agricultural chemists would be able to solve these problems in their laboratories, and furnish the proper information, but although they may render great assistance, complete answers to these inquiries cannot be had without observation of the crops in the field. The chemists can inform us what substances contain certain elements, and their amount, but the plants must be interviewed to ascertain if the form in which it is presented is acceptable to them.

As the soil is the main source from which plants derive their food, all the elements required for their nourishment are equally necessary in it, and if one is wanting, or is present only in a form not readily available by the roots, the plant will not flourish ; and so the fertility of the soil is limited to the amount it contains of the element most deficient. When the proper supply of one element is exhausted, the limit of productiveness is reached. Thus, the farmer may by careful observation in the use of special fertilizers, upon his principal crops, soon ascertain which ones are most needed, by noting which ones each crop is most grateful for. Then, from the different substances furnishing these, he should decide which ones are the most economical for him to use, and the quantity per acre to secure the greatest profit.

I have been requested to give you in a brief manner some of the results which I have obtained in the use of fertilizers. Reports of some of these have been collected and arranged with those of others, and presented with minute details to this board at previous meetings, by the gentleman who is to address you this evening. Still more recent ones are in the course of investigation at the Experiment Station, and will be mentioned in their bulletins at length. I have neither the time nor ability to give you the information to be derived from such experiments that these learned gentlemen can give, and will only notice a few things that have attracted my attention as a common farmer.

On my farm the use of phosphoric acid, in a suitable form, has produced a marked effect each year since its first trial, some thirty-five years ago. It increases the yield of corn so materially that for more than twenty years I have not planted a field of corn without applying this fertilizer in some form, with varying success. I always leave some parts unfertilized to indicate the increase in the fertilized portion. Many different articles have been used for this purpose, but I prefer plain superphosphate, which should contain at least sixteen per cent. of phosphoric acid.

For my main crop of corn I usually spread from twelve to sixteen cartloads of manure per acre on the surface of the furrows, which is then well harrowed in, and from 200 to 400 pounds of the phosphate thrown in the hills, with the corn. This usually gives very satisfactory crops,— much better than is obtained from using double that quantity of manure without the phosphate,— while the twelve to sixteen loads of manure thus saved if applied to an acre of meadow as top-dressing, gives an increase of a ton or so of hay per acre for two or three years. If the larger amount of manure is all put on the acre of corn, the leaves and stalks will be greatly increased without a corresponding increase of the grain; and such is usually the effect of large quantities of manure on all kinds of grain.

Perhaps some farmers will need to substitute potash or sulphate of ammonia for the phosphate, which is so effective with me; but as a general rule, corn is grateful for this element. For potatoes, I omit the manure and use a mixture of the three elements;—usually those put up by reliable dealers, as "Potato Fertilizer." If I use manure on potatoes, the crop is generally scabby, ill-shaped, and very likely to rot, while a liberal use of the fertilizer not only increases the crop, but the potatoes are larger, smoother, and of better eating qualities.

My oats come in rotation, following the corn and potatoes. Yard-manure on this crop is very pernicious, and even an excess from the previous year causes a rank growth of leaves and weak straw, but very light grain. Phosphate gives stronger straw, less likely to blight and rust, and heavier grain. Potash, in addition, has appeared to have good effect. Clover is sown with the oats in my practice, and makes but little growth until late in the fall, or the next year. On this, potash had a marked effect in the few instances that I tried it, and on old pastures a mixture of potash and fine bones brought in a fine growth of white clover at every trial.

Wheat and rye are crops but little grown with me; but from slight use I am inclined to prefer nitrate of soda and phosphate for wheat,—and rye has been greatly increased by the use of fine bone. Buckwheat responds remarkably to phosphates and potash. Plants which have a large growth of leaves, as cabbage, beans, peas, etc., are benefited by the application of potash.

Phosphoric acid appears to be very beneficial to young plants, and I have formed the habit of putting some phosphate in the hill or drill with nearly all kinds of seeds at planting. At first I was very cautious lest it should come in contact with the seeds or plants, but I now think that plain phosphate seldom or never injures them if applied in moderate quantities, while it greatly accelerates their growth. I have doubted if it is of much value, unless the plants have access to it in the earlier stages of their growth and for this reason I like to have it near them, and used alone, as a small quantity of potash or of nitrogen in the forms in which it is generally used is sufficient to prevent germination in the seed, or to injure permanently the plant. At what time or at what depth these latter fertilizers should be applied is uncertain, but there are good reasons for not using all together.

Although a decided benefit has often attended the use of bones and various mineral phosphates when ground fine, yet I think it more profitable to have them first dissolved, at least for crops to be grown in two or three months. The raw ones may do well for winter grain or grass. Although I have in former years made most of the phosphate used on my farm, more recently I have made but little, preferring to purchase a good article in market. But if any one wishes to manufacture it for himself the process is not difficult. Bones which have had the grease and glue removed from them are much easier dissolved than raw ones.

From 150 pounds of steamed, ground bones, separate 50 pounds of the finest. Put the coarser 100 pounds into a steamer or kettle with an equal weight of water, cover, and boil about an hour. Then dip out the contents into a half-hogshead tub while hot, and gradually pour into it about 50 pounds of oil of vitrol, stirring the mixture. When effervescence has ceased, add the remaining 50 pounds of dry fine bones and mix thoroughly.

Many of the so-called "Phosphates," "Fertilizers," etc., with various prefixes and affixes to their names, are mixtures of doubtful utility, and their agricultural values not easily ascertained, even by analysis. These have frequently been used by farmers to their great loss and disappointment. A noted authority in alluding to them says, "Speaking in general terms, it may truly be said that very little knowledge and still less conscience have been displayed in past years in the manufacture of the nitrogenized superphosphates in this country, while for a long period it was customary to sell them at exorbitant prices." Honest manufacturers are also yet in doubt as to the proper proportions for special crops. Much benefit might arise if farmers would purchase the several ingredients separately, and by using them alone or in different combinations, become better acquainted with them.

Except for special crops where manure seems to have an injurious effect,— notably so on potatoes — or where it is difficult to apply it, fertilizers alone may not be as profitable, as when used to re-inforce farm manures. On most of the farms in New England, more or less stock is kept, and the manure, if properly cared for is an important article of the farm products. It may be fair to estimate the market value of the fertilizing elements in a ton of average dung at $3.00, although for obvious reasons it differs greatly. Twenty-five or thirty tons per acre are often used. Try half that quantity with the value of the other half of good fertilizer on an acre and note the result.

Such information as would lead us to a judicious use of plant-food, would, perhaps, prove of as great benefit to us as does the selection of proper food for our stock. I have more good hay in my barn than my cattle can eat this winter, as well as a good bin of corn in my granary. Yet, I buy bran and cotton-seed meal to feed with the hay and corn meal, in the daily rations of my cows, and thereby obtain much more milk, and of better quality than I can from all the hay and corn meal alone the cows will eat. My hogs would loudly express their feelings of disgust if I should confine their food to hay and cotton-seed meal, but butcher offal and meat scraps are delicacies to them, which my horses would regard with horror.

It is more difficult to determine the proper food for plants, than for animals, and the subject is yet, very imperfectly understood. An ignoramus, with little thought or care, may raise a crop, which will be sufficient to keep his family from starvation, but to develop the greatest capacity of the same field would require more intelligence than we shall be apt to find in our time.

The CHAIRMAN. Gentlemen, there will be no discussion at this stage of the meeting, as there is another lecture to follow in about the same line, and discussion will then be in order. Will you listen to some music again?

Another song by the quartette agreeably enlivened the proceedings.

The CHAIRMAN. Ladies and gentlemen, the subject of the next lecture is "Twelve Years of Experiment Stations in the United States," from a gentleman who needs no introduction to an agricultural audience in New England. It is sufficient to say that his works are his greatest praise. I have the pleasure of presenting Dr. Atwater of Wesleyan University (applause).

# TWELVE YEARS OF AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

### BY PROF. W. O. ATWATER.*

*Mr. President, Ladies, and Gentlemen:*

To those of you who were present at the meeting of this board in Meriden just fourteen years ago, when the movement was started which resulted, two years later, in the organization, in Connecticut, of the first agricultural experiment station in America; to the larger number of you who, though not present at that meeting, have followed the movement from its inception; indeed to all who are interested in the continued advancement of the oldest of all arts by newest discoveries of science, it would seem strange if in the review of the subject assigned me, I did not bring before you many things to suggest grateful congratulations for the past and high inspiration for the future. And while it has been a sincere pleasure to me, as chemist, from time to time to recount in these meetings some of the ways in which one branch of my science might be made useful to your practice, the pleasantest part has been in the hearty response you have always given to the sentiment, that after all the highest usefulness of science is not mainly in the increased product of the soil or profit to the pocket which its application brings, but rather in the better thinking and worthier living to which these are a necessary help. So, when we recall that the twelve years just past form really the first epoch of the history of the Experiment Station in America, and that the second is just being ushered in by the provision of the National Congress for the establishment of an experiment station in every State and Territory in the Union, I feel certain that you will approve rather than chide if I ask you to look upon the intellectual as well as in the more practical aspects of the subject. The Connecticut farmer and the college professor have always been on the best of terms. The Connecticut Experiment Station was first started in a college laboratory; its directors have both been college instructors. Neither one of them, I believe, has ever had occasion to feel that the best sentiment of the State did not approve, indeed, did not ask for his best intellectual work. The farmers have felt that their best interests would be most effectively furthered by the highest science.

Experiment stations are for the benefit of agriculture. Yet paradoxical as it may seem, the bulk of the knowledge, the most of the facts and principles which they need to find out for the farm require for their discovery not only the same spirit of investigation, but essentially the same methods of research as are followed in all the higher works of science. Physical science has no profounder problems than are involved in the culture of the soil, the nutrition of plants, and the breeding and feeding of animals. If there is one art above another which requires for its successful conduct the application of the most diversified physical law it is the art of farming.

But to my subject. The history of the Experiment Station of Connecticut is a part of the larger history of the stations of the United States; and those, a part of the still larger history of the stations of the old world and the new together. Not only because it is of interest to us now to recall our experience with our own station, but because there are lessons to be learned from past for future conduct of stations in Connecticut and every other State, does a brief reference to the early history of experiment stations seem appropriate.

A little over thirty years ago, in the year 1851, a company of farmers in the little kingdom of Saxony got together and established, on a farm near the village of Moeckern, just outside the city of Leipsic, a chemical laboratory. For years before, indeed, Liebig in Germany, Boussingault in France, Lawes and Gilbert in England, and other scientists of that time and earlier, had prosecuted researches in behalf of agriculture, but this enterprise in Moeckern marks the beginning of the agricultural experiment station proper. So useful was its work that others soon followed. At the end of five years there were five; in ten years, fifteen; in fifteen years, thirty; in twenty years, fifty-six experiment stations in the different countries of continental Europe. And to-day, after a lapse of thirty-six years, there are in Prussia, thirty-four; in Germany, sixty-one; and in the other European countries, enough more to make the whole number, including the institutions which, variously organized, are all working for the same purpose, not much less than one hundred.

In these stations several hundred chemists, physiologists, botanists, and other men, from two or three to as many as fourteen in each, are constantly at work searching after the precious truths which help farmers in their calling. Studies of the atmosphere and the soil; of the nutrition, growth, and culture of plants; of the feeding and breeding of animals; of milk and butter production, and other matters pertaining to dairying; of the diseases of plants; inspection of fertilizers and seeds; in short, whatever may be done by experimental science to further the great interest they represent, make up the labor of the stations.

In 1876, the twenty-fifth anniversary of the establishment of the first station was celebrated by a meeting of representatives of all the stations at Moeckern. A special volume of the organ of the German stations [*Die Landwirthschaftlichen Versuchs-Stationen,* The Agricultural Experiment Stations] was published in honor of the event. In this a list of the titles of the published memoirs and other accounts of the scientific labors of the stations with references to the publications in which they appeared, occupies 141 pages, and other matter relating to the history and statistics of the stations enough to make 449 pages all told. And the ten years since then, have with the increase of the number and facilities, been years of constant productivity.

A small part of the resources of the European stations is derived from private gift or from fees for work done; considerable comes from agricultural societies, still more is supplied by the government.

To-day the agricultural experiment stations are an integral part of the internal economy of Germany and other European nations. To talk of giving them up would be like proposing to abolish coast surveys or schools. Such has been the progress of the experiment stations in Europe.

### THE ENTERPRISE IN THE UNITED STATES. THE CONNECTICUT STATION.

The veterans who write the war articles in the *Century Magazine* recount their campaigns of the four years of the war in a way that helps us realize what trying but yet inspiring times they were. I feel a little like an old soldier when I think of the two seasons' campaign we went through to get the Connecticut station started, and of the other two years' struggle which it took to get it firmly and permanently established. I suppose most any one of us would, if put back fourteen years, enlist again, but I know one who would not seek the position of recruiting officer.

For years before the Meriden meeting, the Connecticut Agricultural Society, and the State Board of Agriculture, with its long time Secretary, Mr. Gold, and especially Professors Norton, Johnson, and Brewer had been preparing the way. The European stations had been discussed to some extent in the papers and at conventions. The land-grant colleges had made some beginnings in this direction. The Bussey institution had been organized at Harvard University, and Professor Storer's excellent work was appearing. Connecticut farmers were already worked up on the matter of testing fertilizers; in short, the time was ripe for the movement.

Mr. Gold had invited Professor Johnson and myself to lecture at the meeting, and to my inquiry of the latter, my former teacher, what he thought of the advisability of saying something about experiment stations — I was fresh from student life in Germany where I had seen somewhat of their workings — he said, "Yes, by all means, go ahead." The ostensible theme was fertilizers, and the address attempted to tell something about the way in which the German stations helped the farmers in their purchase and use. Professor Johnson followed with a talk about the stations that increased the interest greatly. There was lively discussion and the convention decided that an attempt must be made to have a station in Connecticut. A committee of one from each county in the State was appointed to push the matter. But public opinion must first be worked up. Secretary Gold had a large edition, I believe ten thousand, of extra copies of the lectures and discussion printed, and sent them broadcast through the State. A number of farmers' meetings were planned in different parts of the State at which Professor Johnson, Secretary Gold, and others, including myself, talked experiment stations, and thus the winter's campaign opened.

The result you will find in the report of the next annual meeting of the board, which was held at Woodstock. The committee, as its Chairman, Mr. Webb, stated at that meeting, had concluded from Professor Johnson's estimates that, "to establish it [the station], to get apparatus and chemicals that would be necessary, and to carry it on in such manner that it would be a credit to the State would require about $5,000 [per year]; and then it would have to be managed with the closest economy, and the investigations confined to a comparatively limited number of questions." To raise this amount of money by subscription through the State they thought impracticable, and concluded that the legislature must be applied to. As Mr. Webb reported, "in talking with the members of the legislature not a single objection was made on the part of any lawyer, merchant, minister, or any man from any other occupation than agriculture."

The farmers were the men who threw the obstacles in the way. Some of the agricultural committee favored the scheme, others opposed it, and not a few of the farmer legislators smiled knowingly at the notion of asking them to vote money for scientific experiments to help their farming. But strong petitions had been sent in and strong men urged the measure, and "the bill which provided for an appropriation of $8,000 a year [the sum the committee had concluded to ask for], was retained in the committee of agriculture until near the close of the session, and then reported with the recommendation that it be laid over to the next session of the General Assembly." There was a strong feeling at the Woodstock meeting that the enterprise must be pushed again, and so another series of meetings were held during the winter, and when the legislature convened it came up again. Senator Larrabee, Chairman of the Agricultural Committee, favored it, as did many other men who had been waked up to its importance and usefulness. But it was the men in the back towns who did the most of the voting. They had not attended the meetings of the board, and were not in sympathy with the idea. They understood the value of money, but not of science. I am not here to find fault with them. I came from just that stock myself, way up among the Green Mountains, where the experiment station idea did not sprout until years after it had ripened in Connecticut, and I know that in a good many things they are wiser and better than some of us folks down here. As the session of the legislature advanced it became evident that the bill could not get through the committee, much less through the two houses.

Then, and not till then, Mr. Orange Judd of the *American Agriculturist*, who was at that time a citizen of Connecticut, and by his warm advocacy of the measure in that paper, which had a very considerable circulation and influence in the State, had done much to work up the favorable sentiment that did exist, came forward and made to the legislature an offer on his own part of one thousand dollars, and on the part of the Trustees of Wesleyan University of free use of rooms in the Chemical Laboratory in the Judd Hall of Natural Science, donated by himself to that institution, on condition that the legislature would give $2,800 per year for two years to be used with the amount offered by himself in defraying the expenses for assistants, apparatus, and incidentals, to make a beginning. He argued that two years of the actual working of a station would demonstrate its importance so clearly that the legislature would then take the enterprise and support it well. The men whom the effort had not reached, who were not educated up to the idea of the station, and had little faith in it, knew that the *Agriculturist* was in the way of showing up humbugs and not of supporting them, and when so well known a citizen was willing not only to assure them that a place for the station would be provided, but to pay part of the expense of carrying it on, they were ready to favor the proposal, and it passed.

Pardon an egotistic indulgence in speaking of personal experience if I say that, when at the close of the summer vacation during which this had been done, I returned to the college where I was charged with the care of a department as my regular duty, and found myself, young and inexperienced, with the responsibility of directing this new enterprise imposed upon me, not only without my seeking, but without my previous consent, I was a bit dismayed at the task. But the men who had been most prominent in promoting the enterprise came forward and helped constantly and efficiently, an advisory committee of their number was organized, with Mr. S. M. Wells as chairman, and several of your State board, including Messrs. Gold and Hubbard as members, and so the Connecticut station was an accomplished fact.

Of the history of the station during the two years of its infancy it is meet that I should say but little. A baby with young parents ordinarily gets along very well, especially if there are some grandmothers or experienced aunts and good nurses around to help and advise in the trying times of colic, but although there were plenty of older and interested friends about at this time, this was not only the first baby in the family, but the first one that any of them had had any responsibility for. If there was not wise nursing there was enthusiasm; and, to go further into domestic details, there was occasionally something to be done o' nights.

The work of the laboratory was to be organized and carried on, its scientific phases of course required a deal of time and study, and the practical matters of daily detail were more or less laborious and perplexing. Besides these things, there were the especial wants of the farmers to be met outside; sympathy was to be obtained, and public sentiment in favor of the institution cultivated.

The interest which was excited in Connecticut was extending to other States. All this was encouraging, but meant hard work. With the rest, there was an extensive correspondence to be attended to. I remember leaving the laboratory after six o'clock one night with about eighty letters which were carried home, and answered or otherwise disposed of before the sun rose the next morning.

The reports of the Middletown station, the most of which were included in the reports of the State Board of Agriculture for 1876, 1877, and 1878, contain the story of what was done. Whatever else they may tell of good or bad they have the names of a number of most worthy workers, who have remained faithful to the cause of agricultural science. Such are, Dr. Neale, who has since become widely known as the unusually able chemist of the New Jersey station; Dr. Jenkins, who still continues to serve Connecticut as the efficient vice-director of our own station; Professors Balentine and Jordan, who, the one as professor of agriculture in the Maine State College and the other as director of the Maine Experiment Station, are most creditably serving the interests of scientific agriculture in that State, nor must I fail to mention our lamented Herr Warnecke, who came to us from Germany full of the knowledge and the enthusiasm of a German agricultural chemist, and who afterwards joined the force of the station in North Carolina, but has since died — these have shown by their labors for experiment station science, elsewhere as well as in Middletown, by what sort of men our work was done.

But the Legislature had provided only for two years' support. When the time came around for the test of that part of our success which was to be measured by what the State should provide for the future, I must confess that some of us were pretty anxious. The times were bad. It was in the dark days of 1876 and 1877, not the darkness of winter, but of financial crisis. The Legislators felt that whatever else was done the burden of taxation must as far as possible be relieved. Anyone who spoke of appropriations not absolutely necessary was met with a smile too significant to be misunderstood. The following from the final report of the work of the Middletown station, of which the major part was published in the report of the Secretary of Connecticut Board of Agriculture for 1878, tells what was done: "In due time a bill was presented to the Legislature of 1877, providing for the permanent establishment of the station. The fact that, nothwithstanding the loud call for economy, the cutting down of old appropriations, and the utter refusal of new ones, a bill appropriating $5,000 per annum, permanently and unconditionally 'to promote agriculture by scientific investigation and experiment,' passed both branches of the Legislature unanimously, and with no essential alteration from the original draft proposed by the director and approved by the advisory committee, save such as was needed to give it legal form, was to all concerned a source of great satisfaction."

Thus Connecticut, which, through a bill passed unanimously in the Legislature of 1875, had achieved the honor of establishing the first Agricultural Experiment Station in America, two years later did itself the further honor of placing its station upon a permanent financial basis.

Laboratory accommodations were thereupon offered by the Sheffield Scientific School and the burden of directorship was laid upon Prof. Johnson. The Legislature of 1881 increased the annual appropriation to $8.000 and as the Scientific School was no longer able to give it a home, a further appropriation of $25,000 was made for the acquisition of some five acres of land in the suburbs of New Haven, and appropriate buildings. Thus a permanent place and generous support are provided for an institution whose usefulness is too well known to need telling here.

The example of Connecticut was infectious. Soon after the start at Middletown, North Carolina established a station in connection with the university at Chapel Hill. Later it was removed to Raleigh, the capital of the State, where, as from its beginning, able and enthusiastic workers have verified the wisdom of the southern State which first established an institution of this kind within its borders. In 1880 the New Jersey Agricultural Experiment Station was established by act of the Legislature with an appropriation of $5,000. It was located at New Brunswick, in connection with the Rutgers Scientific School, which is the agricultural college of the State, and has furnished it with laboratory and farm. The Legislative appropriation has been increased, and, if I can rightly judge, no experiment station, even in Germany, has done better or more useful work in proportion to its means and the demands laid upon it, than has the New Jersey station under the direction of Prof. Cook and Dr. Neale and their assistants.

In speaking of the individual stations in the several States in this country and their work, I shall not know where to stop unless it be right here. But I should not fail to at least mention some of the institutions which have since been established and carried on independently of Legislative appropriation. The work done at the Bussey Institution, the Cornell University Station, at Houghton Farm, and other places is worthy of more than a passing remark. At the beginning of the present year some nineteen experiment stations and kindred institutions had been organized in seventeen different States. The scientific work which they have already done has assumed such proportions that the mere cataloguing of publications with reference of sources, is in itself a serious task, as Professors Alvord and Frear, of the Massachusetts and Pennsylvania agricultural colleges, who have this particular matter under their care, will, I think, be ready to assure us. The last Congress, by an act approved near its close, and familiar to all of you as the Hatch bill, has arranged for the establishment of an agricultural experiment station in each State and Territory of the Union, with $15,000 a year to be supplied from the national treasury for its current expenses.

Such, in brief, is the history of twelve years of experiment stations in the United States.

### WHAT THE AMERICAN STATIONS HAVE DONE.

Our stations, then, have passed their apprenticeship and are turning off work with reasonable rapidity and have done so for some time. What is the outcome? Their reports tell part of it but not the whole. If you read them you will see accounts of analyses of fertilizers that have not merely protected farmers from fraud and raised the general qualities of the wares, but have done far more, have helped to educate users as to their proper use. This, by the way, means most efficient scientific propagandism. What is better, researches are accumulating; there has been a great deal of experimenting of many different kinds. Our own station has made studies on the properties of soils which have an important bearing upon tillage, on the effects of different chemicals upon the growth of plants, on forage plants, on the composition of feeding stuffs, and, what is one of the most necessary and useful kinds of work, studies of the methods of investigation. In New Jersey a great deal of research has been devoted to experiments on feeding for milk production, on the culture of sorghum and the manufacture of sorghum sugar, on soils and fertilizers, and the effects of different fertilizers on plant growth. And so as you go through the list of the stations and examine their published reports you find them full of results of experimental inquiry which it would be impossible to enumerate much less describe in an hour's talk.

The different localities where stations are situated, offer special problems for their study, in addition to those of interest everywhere. Compared with what needs to be found out their work thus far amounts to extremely little; compared with its cost it is beyond valuation. For it must be remembered not all the good which a station does is what appears in its printed reports and what is talked about in agricultural papers and farmers' meetings. A large part of what they do is like the action of a hidden fountain, nothing appears upon the surface save the greener herbage, and the larger growth.

Instead of trying to detail what our stations have done, let me call your attention to some things which will serve as landmarks of the late progress of agricultural science, in its application to practice and see if they do not mean a great deal and if a large part of the progress is not due to the experiment stations and the movement which they represent.

Ask yourselves this question. In the year 1875, when the experiment station work began in Connecticut, how many farmers of the country, how many right here in our own State, were familiar with the terms nitrogen, phosphoric acid, and potash; could tell what per cent. of each there ought to be in this, or that, or the other fertilizer; and were in the way of judging of the value of a phosphate or a guano or a potash salt by its chemical composition, and of using it as experience or experiment had taught that it was in place? How many understood that the chief office of these materials is to supply the plant-food that their crops need, and the soil fails to furnish? With all the intelligence, with all the ability, with all the thinking, and all the reading of even the most progressive farmers, the man who knew these things well was a rare specialist. Two or three years ago I noticed an advertisement of a firm of fertilizer manufacturers, prepared for circulation in Connecticut and in the other States thereabouts. It recommended the fertilizers of that firm. There was not a word in it about what remarkable increase of crops they would bring; there was not a single recommendation from a farmer who had put them to practical test and learned their wonderful value from the increase they had brought; but there were statements of percentages of nitrogen, of phosphoric acid, soluble, reverted, insoluble, and of potash, which the fertilizers had been guaranteed by the manufacturers to contain, and alongside these were given the percentages which had been found in the articles as the farmers had bought them, and the stations in their behalf had analyzed them. Now this is a firm of shrewd business men: they manufacture and sell fertilizers to make money. The head of the establishment happens to be interested in agricultural science, and I am very sure would be very glad to do anything he could to help the teaching of agricultural chemistry. But it was not for that purpose that these advertisements were printed and circulated, it was because the dealers had found out that the farmers to whom they wanted to sell their goods looked at just these percentages of fertilizing ingredients and compared them with the guarantees and the prices, in deciding what ones they should buy. They had found that the farmers had learned something of chemistry and were buying their fertilizers on a scientific basis, and that it would pay them to advertise and to sell on that basis. What would any one of you have said at that Meriden meeting fourteen years ago, if Prof. Johnson or I had prophesied that within ten years that would be done in this State of Connecticut?

I remember one thing that Professor Johnson did say. It was that farmers in Germany who had the help of experiment stations to analyze their fertilizers, bought them with the same confidence that they did sugar and nails and cloth. The inference was that Connecticut farmers might do the same if they had an experiment station, and Connecticut farmers are doing it now.

Why, think of it! One of the lively discussions in the *Connecticut Farmer* here two or three years ago was about the question whether it was more profitable to buy commercial fertilizers ready mixed or to buy the raw materials and mix them, and the whole question hinged on the cost per pound of nitrogen and soluble phosphoric acid and potash, as sulphate or muriate, and the like. And the average composition of the materials was discussed with a use of technical terms that a few years ago were scarcely heard of outside chemical laboratories and the fertilizer trade.

Let me cite one more illustration of the late progress of agricultural knowledge. Nineteen or twenty years ago, in your Bridgeport meeting, Professor Johnson gave some accounts of European experiments on the feeding of cattle, and told about the nutritive ingredients of fodder and the ways in which they acted as nourishment. That was the earliest exposition of the subject, on this side of the Atlantic, of which I am aware. Five years later through the Secretary of the Maine State Board I was invited to say something on the subject at a meeting in that State, and attempted to explain some of the experiments in the German stations and their results. Harris Lewis, the President of the New York State Agricultural Society, was present and was inclined to make light of the talk of protein and carbohydrates, remarking that as "American farmers could not have a chemist at every barn door," that sort of a theory would not do them much good. The next winter at the Woodstock meeting of the Connecticut Board, by invitation of its secretary, I discussed the same topic, and to my great satisfaction the physiological chemistry was received with apparent favor. "Protein" and "crude fiber" and "maintenance rations" were new terms, but the gentlemen saw that back of them was something worth knowing. Well, since that time the matter has been set forth in books and papers. The results of foreign experiments have been, in a measure, made accessible to American readers. Our experiment stations have tested them by experiments of their own and with most interesting results. And if you will take the pains to look through the columns of the agricultural papers that have the largest circulation among intelligent farmers, you will notice that they discuss the chemical composition of fodder-materials, the percentage of protein and fats in hay and straw and bran and meal, the proportions of these appropriate to maintenance rations and rations for milk or for fattening, and all that sort of thing; using the chemical terms for the nutritive ingredients as they do bushels and pounds for fodder-materials, and discussing the principles of nutrition as they do the course of the market.

Now when we pause and reflect on these things, — and other illustrations of the same progress will occur to every one of you — are they not remarkable, almost wonderful? We are in the midst of a revolution in this respect. Happily for us it is going on quietly, but it is going on none the less surely.

An illustration of the same general fact of progress in the right direction, because in the direction of the highest application of real science, the most earnest desire for the truth, occurred in the late convention of representatives of agricultural colleges and experiment stations in Washington, who were considering plans for the stations to be organized under the Hatch bill. In all the discussions, whenever reference was made to the manner of disposal of the expected funds and the character of the work to be done, there was the strongest expression of the sentiment that every dollar must be honestly and faithfully applied to the actual purpose, namely, experimenting in behalf of agriculture, and that the best science must be cultivated in the work. And nothing elicited more sympathetic response or more earnest approval than the statement, in an address upon the management of experiment stations, by the Nestor of American agricultural chemists, Professor Johnson, that the fundamental condition of success is the most faithful adherence to the truth.

Who would have thought that at the Meriden meeting there would be such things as these to report at a meeting only fourteen short years later?

Of course this progress of the past few years is not all due to the experiment stations. The schools, the press, the progressive men, the spirit of the time have all contributed to it. But in the existing condition of things in this country the experiment station is and must remain an essential and most important factor.

But I must cite one direct outgrowth of the work of the stations. I use the word outgrowth because it commenced with the station, although it had a force of its own which developed it and has illustrated in its growth and fruit the truth that the influence of the station extends far outside its immediate limits.

The reports of the Middletown station give accounts of field experiments with fertilizers conducted by farmers. The following from the First Annual Report will explain:

"We are continually receiving such inquiries as the following: —'I have a piece of old land that has been somewhat worn down by a number of years' cropping. Will it pay for me to try guano, or superphosphate, or potash salts?'

"'Are the ——— or ——— fertilizers of enough value to farmers in ——— county, to warrant their purchase these hard times?'

"'Will you be kind enough to give me a proper formula for a fertilizer for a corn crop?'"

"No chemist or any other man can prescribe fertilizers for different soils or crops. The difference in different soils or other conditions are too great. For farmers who have not their own experience, or that of others in like circumstances, to guide them, the most sensible method for determining what are the deficiencies of their soils, and how they will be most economically supplied to given crops, is to try experiments on a small scale; to put the question to the soil with different fertilizing materials and obtain its reply in the crops produced.

"In order to facilitate the introduction of experiments of this sort among the farmers of Connecticut, the station has made arrangements to procure materials for the purpose for a limited number of persons willing to undertake the trials."

As the result of one season's experience the plans were slightly modified and a larger number of experiments were made. The *American Agriculturist*, recognizing their usefulness, recommended the experiments to its readers and assisted them in procuring the fertilizers. The results have been given from time to time in the reports of the Connecticut Board of Agriculture, and those obtained up to 1882 were summarized in a somewhat detailed account published by the Department of Agriculture in Washington. The ostensible object of the larger number of the experiments was to work upon farmers' soils, underneath this lay in my own mind a deeper purpose, to work upon their owner's minds. In this respect, as in others, the outcome was most gratifying. I can here only refer to a few points.

With the sets of experimental fertilizers blanks were furnished on which any who should choose were invited to send reports of their experiments. Nearly three hundred experiments were reported to me. They came from colleges, experiment stations, and individual farmers in all the States east, and from some west of the Mississippi, and from several of the British provinces. The quality of the work as indicated by the reports is most gratifying.

The experiments were of two classes. The first, which may be called general experiments, are of a simpler sort and intended primarily for soil tests, involve the use of eight or more different kinds and mixtures of fertilizing materials containing nitrogen, phosphoric acid, and potash. The second class, the "special nitrogen experiments," were of more complicated character, and have had for their object the study of the feeding capacities of some of our more common cultivated plants, with special reference to the nitrogen supply.

### THE FEEDING CAPACITIES OF PLANTS.

The experiments bring us face to face with one of the most important problems with which agricultural chemistry has to deal, and at the same time throw some new light upon it. I refer to what may, perhaps, be most properly called the feeding capacities of plants, their power of gathering their supplies of food from soil and air, and the effects of the artificial supply of different ingredients of plant-food upon their growth.

A vast deal of experience upon the laboratory and in the field bears concurrent testimony to the fact, though we are still deplorably in the dark as to how or why it is so, that different kinds of plants have different capacities for making use of the stores of food that soil and air contain. Of the ingredients of plant-food in our soils, the most important, because the most costly, is nitrogen. Leguminous crops, like clover, do somehow or other gather a good supply of nitrogen where cereals, such as wheat, barley, rye, and oats would half starve for lack of it, and this in the face of the fact that leguminous plants contain a great deal of nitrogen, and cereals relatively little. Hence a heavy nitrogenous manuring may pay well for wheat and be in large part lost on clover.

I cannot go into details of the experiments. Suffice it to say that the plan consisted in applying different fertilizing materials, nitrate of soda, superphosphate, potash salts, and the like, singly and in different combinations to parallel strips of land and noting the effect on the crop produced.

Let me read to you some of the practical conclusions from this accumulated mass of observations by farmers who applied the teachings of the most advanced science to the study of the needs of their soils and crops and the best ways of supplying them. I select one topic, the nitrogen supply, for corn, potatoes, and other crops. Farmers in Connecticut, Massachusetts, and other States have been in the way of expending millions of dollars every year for nitrogen in fertilizers. Corn contains a good deal of nitrogen, and a great deal has often been put into fertilizers for it

The question whether corn can gather its own nitrogen, like clover, or demands an artificial supply, like wheat, whether it is an "exhausting" or a "renovating" crop, has been much discussed. Upon its answer depends in large degree the success of corn-growing in our older States. The experiments referred to bear emphatic testimony upon this point. The corn has almost uniformly refused to respond to nitrogen in fertilizers, and persists in getting on well without any artificial supply.

The experiments I have referred to throw some light upon this question. Among them were a considerable number of the "special nitrogen experiments," referred to, in which the effects of nitrogen in different forms of combination and different quantities were tested. The nitrogen was supplied in the form of nitric acid, in nitrate of soda, in the form of ammonia, in sulphate of ammonia, and in the form which chemists call organic nitrogen in dried blood. With these, superphosphate and muriate of potash were employed. Omitting the results where the ingredients were used singly, let me give you a brief outline thus obtained with the complete fertilizers containing the nitrogen in different forms and amounts. These included in each case a mixture designated as "mixed minerals," which supplied 300 pounds of superphosphate and 150 pounds of muriate of potash per acre. To this mixture the nitrogenous materials were added in quantities sufficient to furnish on the different plots twenty-four, forty-eight, or seventy-two pounds of nitrogen per acre. The effects of nitrogen in the different forms of combination were on the average about the same.

Taking these "special nitrogen experiments" and the "general experiments" in which the mixtures with 48 and 72 pounds of nitrogen were not used, the results with corn may be stated thus. The figures are for bushels of shelled corn:

| In number of trials. | With nitrogen. | | The average increase of corn was— | The increase of nitrogen in the crop was— |
|---|---|---|---|---|
| | Amount per acre. | Contained in crop of— | | |
| | *Pounds.* | *Bushels.* | *Bushels.* | *Pounds.* |
| 95 | 24 | 18 | 4.6 | 6.2 |
| 76 | 48 | 36 | 5.3 | 7.1 |
| 42 | 72 | 54 | 6.6 | 8.8 |

Or, estimating the results in dollars and cents :

| In trials, total number. | With nitrogen, amounts. | Costing. | The nitrogen paid for itself in trials. | The nitrogen failed to pay for itself in trials. | The average loss in the several trials was— |
|---|---|---|---|---|---|
| 95 | 24 lbs. | $5 50 | 21 | 74 | $2 62 |
| 76 | 48 lbs. | 11 00 | 13 | 63 | 6 76 |
| 42 | 72 lbs. | 16 50 | 4 | 38 | 11 22 |

The effects of the nitrogen upon corn, potatoes, and oats may be expressed in another way. Taking the averages of all the experiments (of which I should add that the number with potatoes was much smaller than with corn, and those with oats smaller still), and calling the yield with "mixed minerals" (superphosphate and potash salt) alone, that is to say, with all the materials which are ordinarily contained in commercial fertilizers, except nitrogen, at 100, the amounts of produce with the different quantities of nitrogen will be as in the table herewith:

RESULTS OF EXPERIMENTS ON THE EFFECTS OF NITROGENOUS FERTILIZERS UPON CORN, POTATOES, AND OATS.

| IN EXPERIMENTS WITH— | Corn. | Potatoes. | Oats. |
|---|---|---|---|
| Estimating the yield with "mixed minerals" at | 100 | 100 | 100 |
| The yield with mixed minerals and nitrogen, 24 lbs., was | 111 | 127 | 154 |
| The yield with mixed minerals and nitrogen, 24 lbs., was | 112 | 138 | 166 |
| The yield with mixed minerals and nitrogen, 72 lbs., was | 115 | 127 | 171 |

In brief, the use of large quantities of nitrogen, such as have been often recommended for corn is rarely profitable.

### FEEDING CAPACITIES OF OTHER CROPS.

The results of the experiments with other crops were briefly summarized in an account given in one of the reports of the Connecticut Board of Agriculture, as follows:

"Taking all in all, the potatoes responded well to the superphosphate, the potash salt, and the nitrogenous fertilizers, and the "complete fertilizers," have been most profitable in almost every case where the weather permitted fair growth. None of the other crops, except, perhaps, turnips, have shown such uniformly beneficial results from all the materials.

"The experiments indicate very decidedly that the potato plant differs from many others in respect to the effect of these fertilizing materials upon its growth, and imply that it has less capacity than corn for gathering an adequate supply of food from natural sources. It seems to demand a full and immediately available supply of nourishment for its successful growth.

"Concerning the other crops, the data at hand are too meager to warrant any general conclusions. . . . In general, however, the experiments accord with the common notion that makes superphosphate almost a specific for turnips. But they imply that even when the superphosphate is supplied in abundance, the turnip is not usually able to gather enough of the other materials for a full yield unless they are close at hand in readily available forms."

### THE VALUE OF SCIENTIFIC EXPERIMENTING BY PRACTICAL FARMERS.

But perhaps you think that, after all, though this work may have been a pleasant pastime and possibly instructive to the doers, it was only farmers' science after all, and of no especial consequence either as a contribution to knowledge or for its influence on other farmers. Let us see.

First as to scientific value. Here only a few words will suffice. We Americans respect foreign science as foreigners respect our practical skill. But we think the Frenchmen and the Germans are loth to acknowledge the merits of our achievements in science or in literature. You all know of the French Academy of Sciences. That august body publishes reports of contributions to knowledge by the celebrated men who are its members and by other "savants" whose researches commend themselves sufficiently to its notice and approval. The last figures I read you are taken from an account of these same experiments by American farmers which the Academy published in its *Comptes Rendus* (*Transactions*).

I have here an article from a German journal of agricultural science, published in Munich, where Justus Liebig, the father of agricultural chemistry, so long lived and labored. It is by Liebig's son. It is written for students of agricultural science and scientific farmers in Germany. It gives accounts of farm experiments and their methods and results. It is entitled "What we can learn from America?" The experiments are the very ones I have been telling you about.

I have said that these experiments were made by farmers, experiment stations, and agricultural colleges. Some of them, which have been continued and amplified, especially during the past few years, by institutions which have had means, have now got beyond the range of any individual farmer unless he be a man of wealth. But if a committee of three as good men as you could select were to take the hundreds of reports of those of which I have spoken, study them carefully and select the best experiments, those which gave evidence of the best combination of accuracy, thoroughness, and perseverance year after year, I feel very confident the list would not be confined to those of colleges or experiment stations, but would include, as among the very best, those of two men, who have reported some but not enough of their work at the meetings of this Board, two of your brother farmers in Connecticut, Charles Fairchild of Middletown, and W. I. Bartholomew of Pomfret.

Of the scientific value of their work no words of mine are needed after the other testimony I have brought you. But what of the practical value? The testimony of such practical farmers as Mr. Bartholomew and Fairchild, men who have had their living to make from their farming while they have done their experimenting — and what has been said of them is not laudation, high praise as it is, but cold, hard fact — will surely be more acceptable to you than anything I could say. I quoted the following statements of their's once before [in a report on Field Experiments in the report of the Connecticut Board of Agriculture for 1881], but they will bear repeating.

After the clear practical paper on the results of his experiments which Mr. Bartholemew has read before you this evening, I need not enlarge upon them, but will only cite some statements he made to me some time since in answer to the request that he would tell me in what ways and to what extent the large amount of experimental work he has done has been of actual benefit to him as a farmer. He answered as follows:

"In reply to your question I will say that I have learned to place great confidence in commercial fertilizers when properly used, as furnishing the most reliable and economical materials for increasing my crops."

"I have learned that the effects, of the different substances used, although varying much from each other, are nearly identical in different fields and in different years on my farm, always showing a tendency to the same characteristics."

"I have learned that these fertilizers are much superior in quality to those we obtained before the establishment of the Experiment Station."

"I have learned that this farm, which my father, after fifty years of acquaintance and cultivation, pronounced ill-adapted to the raising of corn, gives me, under similar treatment, with the use of phosphate of lime in addition, in corn one of my most profitable crops."

"I think I have learned that by the proper use of commercial fertilizers as indicated in the different trials, I can obtain, at fair profit, finer potatoes, free from disease and blemish, than by any other means known to me."

"I have learned that by the use of one or more of these substances as adjuncts to farm manures, I have been enabled to obtain at small expense, superior crops of corn, oats, and potatoes with less manure, while the remainder of the manure applied as top-dressing to grass lands, has materially increased my crops of hay."

"And finally, to include the whole matter, I find that I am keeping much more stock, getting better crops, and better satisfaction from my farm than before."

In the course of a long talk with Mr. Fairchild, in which he detailed a number of results of his experiments; I made a similar inquiry of him.

One of the questions to which I solicited a brief answer was this, Can you state some of the ways in which your experiments have been of direct practical utility to you?

The answer was this, "I think they have helped me, and will help me in many ways:

1. They show what fertilizing materials my crops must have.
2. They show me in what quantities, in what forms, and in what ways I should apply different fertilizers.
3. They save me money by enabling me to buy what I want without using a large quantity of materials I do not want.
4. I think I shall thus be enabled to raise all kinds of crops on very poor land with profit.

One of Mr. Fairchild's remarks impressed me greatly. It was this:

"Under the old system of farming, it is no wonder the boys leave their farms. You can't blame them. I did so myself, came back, tried again, and should have given up once more if it had not been for these experiments, and what I have learned in connection with them. As it is, I find myself giving up outside work, devoting myself more and more exclusively to my farm, supplementing the labor of my hands with the labor of my brain, and I feel the benefit in my purse, in my home, and in my mind."

These details of Mr. Fairchild's experiments, and these words as he spoke and wrote them, I have given for a purpose.

Like thousands of boys brought up on an eastern farm, Mr. Fairchild took Horace Greeley's advice, and went West. But circumstances called him home again, and he concluded to try to bring up the old farm. It was up-hill work, and he eked out his income by teaming and other outside labor. Some years ago I became acquainted with him as one of the attentive and intelligent participators in farmers' meetings. One day he took me out to his farm and showed me what he was trying to do. I very well remember a meadow on which he told me he had applied, a year or two before, nearly a ton of fish-scrap per acre, which he had to buy with the proceeds of his outside labor, and haul several miles. So far as appearance showed, it had done no good at all. I naturally inquired if he had tried potash salts. This suggested the experimenting which he began at once.

After one or two seasons' experience, in response to an inquiry as to how he was getting on, he told me he thought he was learning something that would be of great use to him, and added that he found himself devoting more attention to his farm. The next season he told me that he was having better success with his farming, and was giving less time to other enterprises. A year later, calling at our laboratory to make some inquiries he remarked, that he was taking scarcely any contracts for teaming, but was devoting himself almost exclusively to his farm. Last spring he called again and remarked, "My wife tells me I must set up a prescription-shop, so many of my neighbors are coming to find what fertilizers I use for my corn." A few weeks ago he was in again to bring reports of his experiments, and at that time occurred the conversation reported above.

These things I have said with a purpose. There are other Charles Fairchilds and W. I. Bartholomews in Connecticut. I do not believe their neighbors have counted them more wonderfully gifted than any other men, and yet their memory will be green long after they depart from among the farmers of their State, because of the good work they have done. That of Charles Fairchild, whom death removed from us not a year ago, is with us and will remain. But what I wish to urge is that what they have done is but a type of what sorely needs to be done in many places in the State, and by many men, and that Connecticut has the men to do it.

And here I wish to make a suggestion to the Board of Trustees and to Instructors of the Storrs School. That institution has already won a place in the respect and regard of the farmers and the other citizens of the State. But it needs to win more. It can do so, and, at the same time render service to the agriculture of the State in other ways than by teaching boys the science and art of farming. One of those ways is by allying itself with such men as Mr. Fairchild and Mr. Bartholomew; and, with some of the fund it is to have for its new station, securing their coöperation in experimental work.

Farming is in some respects like sailing on a trackless sea with here and there a headland to guide or a rock to wreck. Such men are lighthouses. The more of their light we have, the more safely and surely we shall sail.

### IN CONCLUSION.

In thus recounting to you a few of the many things of interest in connection with the history of the experiment station in the United States, I have dwelt especially upon the one in our own State, and in speaking of what has come of its work, I have enlarged upon what farmers have learned and done through its influence, because this is a meeting of Connecticut farmers. Among chemists, other lines of thought would have been of greater interest. But to every one the theme suggests, as the conclusion of the whole matter, the great advance as well in the science as in the practice of agriculture.

"Science moves but slowly, slowly, creeping from point to point;

. . . . . . . . .

But I doubt not through the ages one increasing purpose runs,
And the thoughts of men are widened with the progress of the suns."

It is much that science does advance, though it be but slowly, it is more that it helps us to easier, more productive, and more profitable labor, but most of all should we rejoice for the intellectual and moral elevation it brings.

And so I close as I begun, insisting that, great as has been the practical value of the experiment station in the United States, great as it has been in Connecticut, its highest usefulness is in the intellectual elevation it causes, in that indirect influence which is unmeasured and measureless.

The CHAIRMAN. The meeting is now open for the discussion of the matter of fertilizers and the lecture of Dr. Atwater.

Mr. WEST. May I speak my views without asking any question upon this matter of the manufacture of fertilizers? We have been in the habit of manufacturing our own phosphate for years. If I were to ask a question I should ask the gentleman from Putnam why he boils the bones? We have never practiced that. We take a half-hogshead and put a hundred pounds of bone in it, put in four or five pails of water, let it stand thirty six hours, then add forty pounds of vitriol, and stir up. Then we throw it out into a bed made like a mortar bed, as any farmer would make who wanted to make a little mortar, using the dust from a charcoal pit when we can obtain it, and when we cannot, we get dry muck or something of that kind. We throw it into this bed, mix in this material, let it lie a few days, then work it over with a hoe as we would work mortar, and get it down to the consistency that we want.

Mr. RANDALL, of Long Island. I have always understood Prof. Atwater to say and to teach that corn did not require any nitrogen. Am I correct in so understanding?

Prof. ATWATER. I think that is one of the cases in which a man may claim to have been very greatly misunderstood, and yet perhaps the gentleman is not at fault; at least I will not find fault with him. Certainly corn requires nitrogen. A brick house requires bricks, but it requires other things. We must have materials to build the house. Corn contains a great deal of nitrogen; it cannot be grown without nitrogen. But I suppose the question is, Whether corn requires nitrogen to be applied in the form of fertilizers. Now, that may be expressed in another way: Is corn able to provide itself from natural sources, from the soil or from the air, or from both air and soil, with the nitrogen which it needs for its growth? All of our ordinary, cultivated plants, even wheat or oats, are able to gather nitrogen from the soil, and corn can also. There appear to be differences in different plants. One can gather more from a given place than another; one can get on better without artificial applications of nitrogenous fertilizers than another can. Clover, peas, beans, and perhaps all the so-called leguminous plants, seem to do pretty well in ordinary cultivated soils without artificial supplies of nitrogen. If you give them enough mineral fertilizers they seem to be able to get along, somehow or other, without nitrogenous manures. Wheat and oats do not seem to get so much nitrogen from the soil. I mean, in our ordinary soils; I do not refer to rich soils. In ordinary soils oats and wheat are not able to get enough nitrogen to give you a profitable crop. Now, corn, on the average, does a good deal better without nitrogen in the fertilizers than wheat or oats. Of course, stable manure supplies nitrogen, but leaving that out and considering only chemical fertilizers, corn gives better crops, in general, with nitrogen than without; sometimes much larger, sometimes the difference is hardly perceptible. But when you take the average of a large number of experiments, such as have been reported, while corn does respond to nitrogen in nitrate of soda, sulphate of ammonia, dried blood, and other things, it does not respond to any considerable extent; and although there are cases in which the response is pecuniarily profitable, those cases are exceptions and the rule is that it does not pay for the nitrogen. I do not mean to be understood by that as saying that you should not use nitrogen on corn. Do as you please. Sometimes it may be profitable when it does not appear so by my figures. I do not know about that.

Mr. **Randall.** I have hardly understood the Professor, perhaps, but I have been mystified with the results of the use of fish scrap as against fertilizers on corn. With us on Long Island a man can get along with what we call fish scrap. He can raise much better corn by the application of that than he can by the use of any other fertilizer. If you take fertilizers containing three per cent. of ammonia, ten per cent. of phosphoric acid, and six or seven per cent. of sulphate of potash, and use about 300 pounds of that mixture to the acre, and put alongside of it a mixture containing six per cent. of ammonia, two or three per cent. less of phosphoric acid, and possibly one per cent. more of potash, you will find a remarkable increase in the crop. The corn will jump with that double quantity of ammonia. Now, these are facts which we see every year in our business and I cannot reconcile them with your theory with regard to the application of nitrogen to corn.

Prof. ATWATER. Let me help you. A little distance out from Middletown, on the top of a hill, lies an old-fashioned New England farm which some time ago was managed by Mr. William Newton. He tried some of these experiments, using different quantities of nitrogen with his corn, and for two or three successive years you might almost measure the amount of nitrogen that he applied in the fertilizers by the increase in the corn. The corn responded to the nitrogen and paid hardly any attention to phosphoric acid, and little if any to potash. Now, if you go to the farm of Mr. Sage, in the town of Middletown, he will tell you that he finds that his corn pays very little attention to nitrogen, very little to phosphoric acid, but it follows up potash just as Mr. Newton's corn follows up nitrogen. Mr. Bartholomew's corn pays very little heed to potash and very little to nitrogen now. Some people say you can prove almost any theological doctrine from the Bible, and if you wish any given theory proved regarding nitrogen you can get the facts for it by selecting the proper soil.

Now, what is my theory ? My theory is that the application of nitrogenous fertilizers to corn, speaking generally, does not pay, but there are exceptions. There are places down on Long Island that are very remarkable. There is a gentleman who has tried a series of very interesting experiments there and he finds his corn and potatoes will respond to nitrogen, to potash, to phosphoric acid, to almost anything that he puts on, in a manner that is perfectly astounding. There are places in New Jersey and in the river counties of New York that will do the same thing; but when you come to take a hundred fields of corn, in as many different places, on the ordinary worn-out soils of our older States, as in Connecticut, and average them all together, they tell just the story I have told you.

Mr. WEBB. I would like to ask one more question. I find in looking over the reports of analyses of stable manure that the average of four analyses, one English and three American, shows of phosphoric acid 8.45 pounds, of nitrogen 11.43 pounds, and of potash 11.30 pounds. Now, the question comes to my mind, What is the best form of fertilizer that the farmer can get? I think the universal answer will be, stable manure of good quality. But unfortunately a good many of us have not enough stable manure and desire to supplement it with some other kind of fertilizer. Under these circumstances what would be the part of wisdom in compounding the fertilizer? Shall we compare it with stable manure and compound it of nearly equal proportions of nitrogen and potash and about two-thirds phosphoric acid, or shall we take the average of four analyses of fertilizers, according to the reports of the Experiment Station for 1886, which give 204 pounds of phosphoric acid to the ton, 89.65 of nitrogen, and 102.15 of potash — being twenty-five times the amount of phosphoric acid in stable manure, eight times the average amount of nitrogen, and eleven times the amount of potash?

Prof. ATWATER. What do I understand the question to be?

Mr. WEBB. Why should we vary in making an artificial substitute for stable manure from the ingredients contained in the article which we consider the best? Why should we not put in the same proportion of ingredients that we find in stable manure?

Prof. ATWATER. Supposing I should ask a tailor why he makes a coat for Mr. Webb of such a different measure from the coat he makes for Mr. Gold? (Laughter.)

Mr. Webb. He would give me the same cloth that he would Mr. Gold.

Prof. Atwater. But he uses different proportions, does he not?

Mr. Webb. Yes.

Prof. Atwater. Now, then, you want to use different proportions of potash, nitrogen, and phosphoric acid in your fertilizers in one case from what you do in another. The only answer to your question is, that it depends upon the soil and the requirements of the various plants. By patient investigation we can get at more or less closely what plants require, but different soils differ widely.

Mr. Webb. I simply want to know why we should vary from the proportions of that kind of fertilizer which the farmer from his experience has found to be of the first quality?

Prof. Atwater. Because it pays to vary and does not pay to follow those proportions.

Mr. Inglis. A few years ago Prof. Atwater got up a series of fertilizers, some all phosphoric acid, some all potash, some all nitrogen, and some mixed. I have forgotten the exact number, but there were some five or six different little bags. I got those bags, I tried the fertilizers, and the phosphoric acid alone went entirely ahead of everything else. I think this proves what Prof. Atwater has been saying here. I tried them on corn; I tried them on old cultivated land on a hill; I tried them in the valley below on land that I had just ploughed, and the effect was just the same. I want to say one other thing. Some five or six years ago I was using on a piece of corn some of Bowker's corn manure containing some nitrogen, and I used some of Bowker's clear phosphoric acid, and the phosphoric acid went clear ahead of his corn manure containing nitrogen. I thought from that experiment that my land wanted phosphoric acid alone, and I have come to that conclusion definitely in regard to corn and have almost ceased using anything in the form of nitrogen. But some few years ago I was induced to use a little nitrate of soda. I put it on wheat and rye and the result was astonishing. It only proves what some gentlemen have been saying here to-night. As far as Prof. Atwater's theory is concerned I must say I believe it will stand the test. I have consulted him frequently for years to find out what my land wants.

Mr. **Platt** of Saybrook. I would like to inquire of Mr. Bartholomew whether he has used his phosphates from unburnt bone, containing considerable ammonia, or whether he has used his phosphates derived from sugar-house refuse, from burnt bone, and from South Carolina phosphates? If he has used those phosphates which are free from ammonia, I would like to know what the practical results have been from them.

Mr. **Bartholomew**. I have used phosphate made from dissolved bone-black, which I think is nearly free from ammonia, to a considerable extent. I have also used dissolved bone, which I think the gentleman is correct in saying has some nitrogen in it. I discover very little difference between that which is made from the dissolved raw bone and that which is made from the dissolved bone-black.

Mr. **Platt**. I would like to inquire further in regard to his soil. I have found that the character of the soil makes a great difference.

Mr. **Bartholomew**. It is what I call rolling, hilly land; dark loam, with a clay subsoil underneath.

Mr. **Oakey**. I think all authorities agree that corn receives a large amount of its nitrogen from natural sources and that soils differ in furnishing this kind of plant-food. Now, I want to ask Prof. Atwater if he wants to leave with us, as the result of his experience and knowledge, the idea that corn receives all of its nitrogen from natural sources, and that it is not economy for the farmer, taking the average of the soils, to supply any nitrogen whatever from an artificial source?

Prof. **Atwater**. I cannot answer that question. I do not believe the man lives who can give you a square answer.

Mr. **Oakey**. What is your opinion?

Prof. **Atwater**. I have not any opinion on the question, sir. I have no right to have an opinion, and for a very good reason. If soils were all alike we could go to work and experiment and expect to be able to answer your question, but they differ. Now, corn gets enough nitrogen from natural sources, if there is a sufficient supply in those sources for it to get; but if you give it nitrogen in fish scrap, nitrate of soda, and so on, it will usually give a little larger yield; in some places very much larger, in others very little, and in some places none at all. I take it that the soil is the principal factor; but there are processes going on in the soil which we do not understand, and if we did understand them, we should find that they are very complex. There are a great many factors which enter into the problem. It makes a great deal of difference whether the season is wet or dry, cold or warm, what is the texture of the soil and what accumulated store of plant-food it has from the weathering of its minerals, the residue of plant-growth, previous manuring or other sources.

Now, to answer your question the best way I can, let me say, first of all, it is impossible to lay down any rules. What is profitable for one place is not profitable for another. It does not pay Mr. Bartholomew, according to his years of experiment, to buy any considerable quantity of nitrogen to put on his corn; it does pay Mr. Newton to do it, and it pays other men to do it. Now, if you asked me what I would advise the average farmer to do, I should say, let him study his soil by experiment and find what is the most profitable and then follow his experience. I cannot lay down general rules, because it did not seem best to Divine Providence to make all soils and all seasons alike.

Prof. JOHNSON. I feel moved at this stage to make a few suggestions. I have been familiar with the cultivation of corn on an extensive scale in New York State, and the almost invariable practice there (a practice that came from Connecticut) was to plant corn on the inverted sod. Now, in such cases there was a store of nitrogen laid up in the grass roots which became available for the corn. That was a natural source in one sense, an artificial source in another. We may properly reckon the inverted sod, the stubble of previous crops, and the unexhausted residue of previous manurings, as part of the food for the current crops, but it is easy to lose sight of these factors and leave them out of our reckonings. So I say it is possible that in some, or in many of those experiments to which Prof. Atwater alludes, the failure of nitrogenous applications to increase the Indian corn crops may have been due to the fact that the soil had already sufficient nitrogen in temporary store for that crop. In order to judge of these experiments fairly we should have in each case an understanding of the history of the field itself and know how much of the supply of nitrogen is to be attributed to the residue of the previous crop, and how much to the regular natural sources.

There has been inquiry as to what may be the reason why the corn crop is able to supply itself with nitrogen from natural sources more largely than some of the other crops, as wheat. One reason evidently, is the deep-rooted character of the corn plant. When I talk about its "deep-rooted character" I do not mean that corn is necessarily deep-rooted; but I mean that when the soil is comparatively poor, when the plant-food is sparse and scattered, the corn plant is able to send out its roots to great lengths and depths in the soil and can forage upon a wider field than the ordinary cereals whose natural root-system appears to be more limited in its range. We know that wheat grows best upon a somewhat close-textured, tenacious soil. We know that natural corn land is sandy loam; land that is open and porous, and upon which wheat does not flourish, other things being equal, as upon more clayey land. These differences which we observe in the soils adapted to these various crops seem to stand in some way related to the natural spread of the roots. Corn is probably able to go further and forage deeper for its nutriment than these other crops, and therefore it may do better upon a field that has a small proportion of nitrogen in the soil, with a small amount of nitrogen applied on the surface, than other cereal crops whose root development is naturally more limited. While Dr. Atwater's experiment and our ordinary experience tend to the conclusion that in older countries wheat requires nitrogen as a fertilizer, while corn can get along without it; on the moist, rich soils of our western prairies it has been the experience that corn will grow remuneratively where wheat will not, because of the excess of plant food, and on the very richest soils of the West the early farmers found it necessary to reduce the fertility of the land by repeatedly cropping with Indian corn before they were able to get a crop of wheat. This was not because the wheat would not grow, but because it would not stop growing; because it would not finish forming new stalk and leaf and begin elaborating the seed. On those rich soils the wheat grew, but it grew to straw. Corn also grew tremendously to stalk, but was able to produce itself and give a large crop of ears and seed. These differences in the corn plant and in the wheat plant have something to do with the apparent fact that corn does not require so much of the nitrogenous fertilizers as wheat, and is able, as Dr. Atwater says, apparently to draw its supply of nitrogen from natural sources. Although those two plants belong to the same natural family, they differ extremely from each other in their general habits of growth; and we may reasonably conclude that they make different demands upon the soil.

**Mr. May.** You know I am from the extreme northeasterly part of the State, and we in our section are far away from the Experiment Station; we do not come in contact with these scientific men; we do not understand these chemical terms — "perverted" and "inverted phosphoric acid" (laughter); but we have used large quantities of commercial fertilizers, first and last, in that vicinity, and the question with me always has been, and is to-day, whether the mass of the farmers of Connecticut are any better off financially, to-day, than they were before they commenced this wholesale use of chemical fertilizers. I would like to get from these men who have grown gray in agriculture some expression of opinion that will be reliable concerning these things that I may take home with me. I have been in the dark, I am in the dark to-day, perhaps from ignorance, but if I cannot get any light, I must either use more commercial fertilizers to make my farming operations profitable, or use less, and take Mr. Webb's advice, save what the farm makes and apply it more scientifically. I would like to hear the opinion of the farmers who use these fertilizers. Mind you, if a man plants fourteen acres of potatoes and applies two or three hundred dollars' worth of phosphates, for which he has to pay cash, and his potatoes go back on him, he is on the down-hill road. Prof. Atwater has said that while one soil would respond to this treatment another would not, so that one man is growing poorer while another is growing richer. I would like to know whether that is about an even thing.

Mr. FISH of Mystic. I feel like saying a word in answer to Mr. May's suggestion. I have had fifty years' experience on the same piece of land. I have raised large crops and small crops, and at this time I am not able to tell beforehand what effect manure will certainly have upon my land. I find that the application of manure, at different times, and under different circumstances, produces very different results. For instance: I have used quite largely fish scrap. I am not in the northeast or northwest corner, I am in the southeast corner of the State, down near Fish Island Sound, on high land. My land is rock bound, very stony land naturally, but quite a tenacious, heavy soil. Last year I sowed a little piece of winter wheat. The application of fertilizers to that piece was about ten loads of ordinary farm manure to the acre and six hundred pounds of ground bone. The result was, the wheat grew five feet tall, and when thrashed, turned out forty bushels to the acre, although the wheat winter killed, to some extent, because the land was so wet. Now, there seems to be a result which it would be very desirable to obtain again. I have sown more wheat this fall, and treated it in exactly the same manner, yet I should not be surprised to find, when the next harvest comes, that my wheat did not show any such result, although the land is just over the fence from the field which I sowed last year. My experience in these years of farming has been, that the application of manure, at different times, has had very different effects. I have applied fish scrap in liberal quantities as a top dressing for grass in the spring and have seen no result from it. I have done the same thing another year, under similar circumstances, as far as I could see, when the grass grew so rank that it lodged.

I make these remarks to show that after all these experiments that we have heard mentioned by Prof. Atwater and others, interesting as they are, there seems to be occasion to doubt. We do not quite understand whether we have got to the bottom of the matter. I recollect asking Prof. Atwater, several years ago, what to do with my land. I had applied fish scrap and got enormous crops of hay, and my corn grew large. I have raised as large crops of corn, I will venture to say, as have been raised anywhere in this State, with the aid of some fish scrap, some ashes, and some stable manure, but what then? After this land was laid down to grass I raised something else which I did not want. My land was red with sorrel. I believe I could have produced sorrel seed enough to have sown all the land you wanted to sow in Connecticut. I asked Prof. Atwater, "What shall I do? Here I am raising sorrel." Said he, "I guess I would apply ashes." I went to Mr. Bill and bought ashes, spread the ashes upon the land, and the sorrel is gone. Prof. Atwater's idea was right. Now, what shall I do? I have applied this phosphate which our friend applies with so much success and I have found it does not have a very good effect with me. It hardly increases the crop of corn and never pays for applying it to grass land. This, gentlemen, is not all guess-work. I never put phosphate on a piece of corn yet, without leaving it out from some of the rows to see what difference there was in the result. I have abandoned phosphates after the experience of years. Now I am trying bone, and so far it has done well.

The object of these remarks is to emphasize the idea that we must take all these experiments with a large grain of allowance. There are a great many things to be taken into consideration that it takes a wiser head than mine to understand. I do not know what to do under these circumstances. When I find the application of barn-yard manure on top of the ground in the fall of the year, just when old and experienced farmers tell me it ought to be put on, when I find such an application has no effect one year, and when I try it again and the result is everything that could be desired, I ask myself, What is the matter? It must be there is something that I do not understand, something back of all this.

After this experience of years, as I have said, I felt as though I was just in the stage to learn, and I came here to hear the results of experiments, and I have been greatly interested. I hear that I am to do this, that, and the other. I think the only thing for me to do is to go home and try it.

Mr. CHEEVER. There seems to be a lull of a moment and I would like to take this opportunity to put in a protest, and if the learned gentlemen present believe that I am wrong in it, I hope they will express the feeling. I do protest against using the term "barn-yard manure" in the sense of a yard-stick by which to measure the value of fertilizers. What do we mean by "barn-yard manure"? Do we mean horse manure that has been burnt up? Do we mean strong cow manure from cattle that are fed heavily on cotton-seed meal? Do we mean hen manure? Do we mean hog manure? Do we mean swamp mud drawn into a cow-yard, trampled a while and drawn out again? What is there about barn-yard manure, using that term in the common sense, that is in any sense a yard-stick to be set up as a standard of what fertilizers should be? I cannot see it so.

One word more. Nitrogen has been spoken of and it has been stated that the application of nitrogen is not necessary in some cases, because the crop obtains it from natural resources, and Mr. Bartholomew's experiments have been mentioned in that connection. If I did not misunderstand him, when he was reading his account he spoke of putting some twenty loads of stable manure of some kind, per year, on his land, and then putting some fertilizer with it. Did he not get plenty of nitrogen in that stable manure, if it is as good as I think it is, and is that a natural source of nitrogen?

One word more in regard to the thought I had in my mind as to taking barn-yard manure as a standard. In the town of Princeton, a generation ago, an old farmer, well known there, set apart a piece of land — light loamy soil — for a garden, fenced it off from the rest of his farm, and kept it for many years as a kitchen garden. The business of the farm was feeding cattle for market. They were fed high, the manure was good; it was drawn on to that garden and spread liberally, as a liberal farmer naturally might. It went on for forty years, perhaps, producing good garden crops; but at the end of that time, for some reason not understood by the owner his crops began to fail and fail seriously. His squashes produced vines but no fruit. The same with beans, the same with corn, and with many more of his crops. He went to a neighbor, old Mr. John Brooks of Princeton, for counsel and advice. He asked him to come up and see his garden. Mr. Brooks went up, and on arriving upon the ground the first thing he noticed was that the garden seemed to be about a foot higher than the soil around it. It struck him that that might afford a solution of the problem. He inquired about the history of that piece of land, and he found that for some forty years heavy dressings of rich stable manure, with more or less straw in it, had been spread on that land, year after year, and the soil was actually filled with something that prevented those crops from making profitable returns. He thought he would venture advice. He saw five or six acres near by that seemed quite thin and poor, that did not even bear squash vines luxuriantly. He suggested to the owner that he hitch up his team and cart off a foot of that soil to top-dress the rest of his farm. He accepted the advice, followed it, and the next year had a most wonderful crop of grass from the five or six acres. The rest of the advice was — "Then go on as usual; put your barn-yard manure on your garden a foot below where you have been putting it, and see what the results will be." He did so, and the result was that his garden was restored to its former productiveness.

Mr. **Bartholomew.** I think Mr. Cheever must have misunderstood me in regard to the application of phosphate and barn-yard manure. When I apply twenty loads of manure to the acre it is not for the corn crop alone. I usually stock the land down the next year with oats and grass, and I find the effects of that manure remaining in the land for several years. I do not suppose that all the manure, and perhaps none of the phosphate, goes into the corn crop. There is a great deal left in the soil.

Mr. **Olcott.** I wish, Mr. Chairman, to remind you that at our meeting at Torrington there was one paper promised us that was left out of the course — Prof. Johnson's paper on nitrogen. I came in just as Mr. Fish was finishing what he was saying, and I was exceedingly interested in what I heard of his remarks, and also in what Mr. Cheever has said. It seems to me that if either of those gentlemen was to speak freely about his experience in breadmaking and the use of yeast there would be some curious things come out bearing exactly on what these gentlemen were just now saying. It seems to me that any of these scientific gentlemen must know from the talk of my friend Fish and my friend Cheever that there is a chance for manure, as a ferment, bringing something besides nitrogen, phosphoric acid, and potash to the soil, — that it may bring something to life in the soil, and I wish these scientific gentlemen would take that matter up. I do not feel able to.

Mr. **Gold.** Is Mr. Sedgwick in the house? If he is, I wish he would state the effect of the application of barn-yard manure to his garden and the subsequent effect of the application of salt.

Mr. **Sedgwick.** I think I have stated this at one of these meetings several years ago. My farm-house was built in the year 1800, and ever since that time the same garden spot has been in use. It is very favorably situated to receive a copious dressing of manure from the hog pen, as all that has to be done is to throw the manure over the fence and spread it on the garden. It also has the benefit of the washings and drainings from the house. Ten years ago, I think, we began to notice that our beans, for example, did not fill out well; they would largely go to vines; the tomatoes ran up a good growth of vines, but the crop did not mature. It was the same with other vegetables; squashes more particularly. It occurred to me that the trouble was that the garden had been manured too long with stable manure, and one year I omitted it entirely and put on a dressing of salt. The result was that it was completely renovated. I think we had the best crop that season that we have had since I recollect it.

The CHAIRMAN. How much salt to the acre?

Mr. SEDGWICK. That is a pretty hard question to answer. I should say that on a garden spot eight by ten rods we applied some six or eight bushels, fully six bushels, if my recollection serves me right, and I think some more than that.

Prof. JOHNSON. This case appears to be very closely related to the matter to which Mr. Olcott has referred. In a barn-yard filled with stable manure and straw, and used for a garden, you could not expect a crop of anything very valuable. Most garden plants would not flourish in soil of that kind. There is too much life of the wrong sort in a place like that. In decaying animal matter we have vast numbers of microscopic organisms, which, under proper conditions, constitute what is called "septic or putrefactive ferment." If you take fresh meat, a piece of beef or mutton, put it into a long-necked vessel of glass and boil it with water in that glass vigorously, for some time, so that steam is rapidly escaping, and while it is boiling thrust a plug of clean cotton wool, an inch in length, down the neck of the vessel, and then allow the whole to cool, that beef or mutton broth will stay sweet for months or years. In this experiment, just as in the canning of meats and fruits, the germs or organisms which occasion putrefactive decay are destroyed by the hot steam; but if you expose beef or its broth to the air at ordinary temperatures for a few days it will begin to putrify, and in a week or two it will be thorougly rotten; and where these putrefying germs are found little else of a higher order, whether of plants or animals, will flourish. They take nearly absolute possession. Suppose you have a cornfield of five acres, the corn up a foot and a half high, and you turn into that field a herd of cattle, how much corn do you expect to get from your five-acre lot under that treatment? Now, stable manure, if put into the soil in great quantities, especially if much moisture be present, becomes a hot-bed of those low organisms which may prey upon and destroy the higher organisms. There is a limit to the profitable use of stable manure in the soil.

But there are other kinds of organisms whose presence in the soil is favorable to vegetation, and a moderate quantity of stable manure put into soil that has sufficient exposure to the air is as beneficial on the one hand, as an excess of it with an excess of moisture and lack of air is detrimental on the other.

As regards nitrogen in the soil, we have in the residue of farm crops, stubble and decayed roots, and in the stable manure which we put upon the land, this element, to a large degree, in a state which is not available, directly and immediately, as food for plants. Swamp muck may have two or three per cent. of nitrogen; old boots, five or six per cent. of nitrogen. If you plant in swamp muck or pulverized leather you do not get a crop unless provision is made by which the inert nitrogen passes into an available condition. The natural process by which inert nitrogen is made available is called, in scientific language, "nitrification" — the formation of nitrates or saltpeter — and this process has, within a few years, been conclusively shown to depend upon the presence of special organisms, so small, that with the highest powers of the microscope, you can just see them, but can scarcely distinguish them from a variety of other similar organisms. These little scavengers, which feed upon the worthless matter in the soil, must be present, in circumstances favorable to their life, in order that this particular kind of plant-food shall be made available for the higher life of our cultivated plants. The evidence on that point is most conclusive. It has very lately been shown that the process which we commonly call "fermentation" in the soil, or the harmless decay of vegetable matter, is conditioned upon the presence of still other organisms, and that the circumstances which favor their development favor this process, and the circumstances which hinder their development hinder it also. So that probably all those natural processes which we call "fermentation" in the soil or the compost heap, as well as putrefication in the moist or wet mass of decaying manure, or in animal liquids and nitrification, are dependent upon the microscopic life in the soil. Here is a field which, under proper cultivation, will most probably, give us a great harvest of ideas and useful hints in agriculture. I cannot do better than to refer you to the book of Prof. Storer, "Agriculture in some of its relations to Chemistry," recently published, in which many of the results of recent investigations into this matter are set forth in their agricultural bearings very fully, and they are of great value.

Adjourned to Thursday.

## SECOND DAY.

The Convention met at 9.30, Hon. E. H. HYDE in the chair.

The CHAIRMAN. I have been asked to preside this morning, and it is certainly a pleasure to any gentleman to preside over a meeting of this kind, and especially is it gratifying when we contrast this meeting with what we saw a few years ago, when it cost a man something to be engaged in active, progressive farming. In the early days of this organization it was difficult to get as many men together as I see here on this seat directly in front of me. It will soon be difficult to get a house large enough to contain the men who are interested in agricultural science and progress.

I should not take up your time. The meeting is now open for business, and the Secretary will proceed to open the question box.

Sec. GOLD. "Is it best to feed cows all the corn meal and wheat bran they will bear?"

Mr. **Cheever.** I do not know exactly what is meant by what they will bear. Yes, what they will bear and pay for and keep healthy.

Sec. **Gold.** Corn meal may be fed to a cow to such an extent that, while her health is not injured, yet her returns to the milk pail are decidedly interfered with. It depends upon the character of the machine how much it will bear. A few years ago I had a large thoroughbred Ayrshire cow, that I desired to dry off and fatten, and I gave orders to increase the corn meal to a degree that I believe in the case of any other animal in my herd would have resulted in interfering with the milk supply. My men soon told me that I was not going to dry off that cow that way. The more feed they gave her, they said, the more milk she gave. She was one of those milk machines adapted to consume and assimilate a large amount of rich food. With regard to feeding any rich food, like Indian meal, I will say that I would not put the same amount before each cow, but each animal should be fed according to her individual condition and power to assimilate and use to the best advantage these richer foods. To the general question, "Is it best to feed cows all the wheat bran and corn meal they will bear?" that is, to run the machine to its full capacity, I should heartily say with Mr. Cheever, "Yes."

The next question is: "Is tuberculosis contracted by fowls from eating the expectorations of persons afflicted with consumption imparted to persons eating the flesh of those fowls?"

Rev. W. W. **Meech** of Vineland, N. J. I have a parishioner who came from that portion of the country where consumptives have been in the habit of going. He says, that in some of those regions where consumptives have gone with great advantage, they can no longer go with the same advantage by reason of this very fact, that their expectorations have been thrown upon the ground, picked up by fowls, and the disease has been communicated to people eating the flesh of those fowls.

Dr. **Foote.** It is a well known law of nature that "like produces like." Tuberculosis will produce tuberculosis.

Sec. **Gold.** "Which is the best way to apply commercial fertilizers to corn, in the drill or broadcast?"

Mr. **Ayer.** Broadcast, every time.

Sec. **Gold.** Any one else vote on that question?

Mr. ———. Both in the drill and broadcast.

Mr. **Augur.** I believe in that.

Mr. **Ellis.** The best way to apply fertilizers to corn is through the drill. The ground takes the fertilizers very readily from the drill, and the crop receives the benefit much better than if the fertilizers are scattered broadcast and harrowed in.

Sec. **Gold.** Here is one other question on feeding. "What is the best grain ration for the development of young dairy stock?"

Mr. **Webb.** I am inclined to think that for the development and growth of young animals a good quality of hay, with a mixture of oats and rye, will be a very good ration. The proportions I cannot tell, but give a well-balanced ration. If I were to answer the question generally, I should say, feed them well and thoroughly of the best you have got.

The **Chairman.** I congratulate you upon being so fortunate as to have with you a gentleman not only well known in this State, but all over the States of this Union, as interested in a matter which concerns us all. You have heard him so often that it would hardly be in good keeping for me to introduce this gentleman. His subject will be—"Arbor Day: What to plant and how to plant." I now present to you Prof. Northrop. (Applause.)

## ARBOR DAY—WHAT TO PLANT AND HOW TO PLANT.

By B. G. Northrop, LL.D.

Connecticut, by its new law relating to shade trees upon highways gives greater encouragement to this work than any other State. The following is the amended act:

"Every person, planting, protecting and cultivating elm, maple, tulip, ash, basswood, oak, black walnut, hickory, apple, pear, or cherry trees, not more than sixty feet apart, for three years, along any public highway, shall be entitled to receive from the State Treasury, an annual bounty thereafter of ten cents for each tree so planted and cultivated, but such bounty shall not be paid for more than five years, nor any longer than such tree or trees are maintained."

This liberal bounty of fifty cents for each tree, together with their prospective beauty, utility, and real value to the planter, should prompt our farmers and all owners of land by the road-side to a still more general planting of shade trees. Our schools and citizens generally should redouble their interest in this good work on our next Arbor Day. Another stimulus may be found in the remarkable spread of this Arbor Day movement over the country. When the Connecticut Board of Agriculture at its annual meeting in January, 1885, appointed me as their delegate to the State authorities in the other New England States to secure concurrent action on forestry, so prompt a response from all on the subject of Arbor Day was not expected. A similar commission from the American Forestry Congress also has been unexpectedly successful At the outset, interviews with eminent State officials were not encouraging. Several governors and school superintendents at first deemed it an unwise project, who, on fuller information have heartily endorsed it and zealously worked for its success. The logic of events has answered objections and secured a general approval of this measure. Already Arbor Day has been adopted in twenty-six States and territories by legislative "act" or by special proclamation or recommendation of the governor, or school superintendent. These officers in seven other States now promise to "urge such action upon the next legislature."

In answer to the question, what to plant by the roadside, the Connecticut law is specific so far as relates to the State bounty. This list is a choice one, consisting mostly of our best native trees, well adapted to our soil and climate. Connecticut is rich in the variety of its valuable forest and ornamental trees. The elm, maple, and most of the others named are too well known to need any recommendation. For variety, the Norway maple deserves special notice, being acclimated and hardy, a rapid-grower, with leaves of a rich deep green color, larger and thicker than those of the sugar maple. The tulip tree, or white wood, sometimes called yellow poplar, though it is not a poplar, ought to be a greater favorite. It is indigenous in New England and along the Atlantic coast even to Florida. In Canada West and in the Western States, it sometimes reaches the height of one hundred and twenty feet, with a diameter of five or six. It is a stately tree, and with its magnificent columnar trunk, large limbs, throwing out branches at all angles, large truncated leaves and magnolia blossoms, it may rank in grandeur and beauty next to the elm or maple, as an ornamental tree. Why then is it so seldom found as a shade tree? I answer, because of general failure or supposed difficulty in transplanting it. After recommending it in my lectures, I often get the statement, "We have tried it again and again and they all died." So they will be sure to fail when maltreated, as the elm and maple formerly were — planted when large as your arm and beheaded. The tulip, like others of the magnolia family, and indeed all trees, should be planted when very young. The owner of the largest nursery in this country, east of Syracuse, said to me: "You will accomplish a grand result for arboriculture if you persuade the people to plant young trees." Those which are planted when large and then beheaded never recover from this unnatural process, not even the elm, though prone to assert its claim to peerless symmetry, however abused. It gives you, perhaps, two limbs and then from three to six feet higher two or three more, when you might otherwise have a dozen growing out in graceful arches.* Just here has been the greatest hindrance to the most successful tree-planting in the Atlantic and Central States. The new West is now teaching the East a much-needed lesson in favor of planting very young trees. The experience on the prairies and especially in the trans-Missouri River States, where this work has been carried on to a vast extent, is decisive on this subject, certainly so far as relates to economic tree-planting. The six hundred millions of trees now said to be growing in Nebraska, were mostly planted when mere saplings. The same is true of the planted forests of Kansas and other Western States. Their leading nurserymen, some of whom sell millions of saplings annually, all say: "Plant small trees. They are easily dug up, and 'lifted' too, with all their capillary roots and finest fibres, and hence are more sure to grow. They cost less to begin with and are more easily transported and more cheaply and rapidly transplanted." Said one of these Western experts: "For my own use, I would not accept three-year-olds as a gift, where I could buy yearlings at a reasonable rate." In ten years the yearlings will overtake those ten years old when planted and be always healthier and handsomer. In school yards, private grounds, and by the road-side, it may be needful to plant larger trees and to stake them for protection, but even here the stem need not be larger than your finger. When those by the road-side stand sixty feet apart, plant between them some rapid growers, like the poplar, cottonwood, or willow, started from cuttings, to be removed when the choicer trees need the space.

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*If any land owner objects to the elm because it extends its roots near the surface and far into adjoining fields, let him take the white ash, tulip, basswood, hickory, or either of the fruit trees named in the Connecticut Act, quoted above. The planting of fruit trees is wisely encouraged by this law. The pear and cherry are graceful and excellent ornamental trees for the way-side, aside from the value of their fruit. Such trees often line the road-sides in Europe.

Under the stimulus of both Arbor Day and the State bounty, more trees ought to be planted next Spring than in any former year, however much has been already done. Nothing can add so to the beauty of our country roads as long avenues of fine trees. One sees this happily illustrated in many countries in Europe for hundreds of miles on a stretch. Growing on land otherwise unused, such trees would yield most satisfactory returns. The shade and beauty would be grateful to every traveler, but doubly so to the planter, as the happy experience of many of our farmers can now testify. In some portions of Germany, every landholder was formerly required to plant trees along his road frontage. Happy would it be for us, if the sovereigns of our soil, the landowners, would each make such a law for himself. "By so doing we should think more of home, town, State, and country, and more of each other." When every resident makes his own grounds and wayside attractive, an entire town may become so inviting as to give new value to its wealth and new attractions to all its homes

*How to plant.* — Some practical directions may help scholars, teachers, parents and the public generally in the observance of Arbor Day. Let the holes be dug beforehand, and deeper and wider than is needful to receive the roots when spread to the utmost. Great care is needed in "lifting" or digging up the trees, so as to get the most and longest roots possible, and especially the fine capillary rootlets, which, as little mouths, form the vital connection between the soil and the tree, absorbing its nutriment in solution as water or gases. Trees are often torn up so harshly as to leave their finest filaments in the soil. It would be an immense gain if all tree planters realized how essential are these delicate thread-like fibers, and how soon they lose their vitality when exposed to the sun. Most failures come from getting insufficient roots and rootlets, and allowing the fine fibrils to get dry. Carelessness just here kills thousands of trees outright, and dwarfs still more. When first dug up, the roots should be set in a box or barrel, and covered with moist leaves, or protected by a mat or canvas, or buried in earth. If any roots have been torn or broken in lifting, their ends should be cut smooth with a sharp knife. Many buyers look at the tops rather than the roots, forgetting that ample, fresh roots will make the top thrifty and symmetrical. When properly dug and protected, trees from the nursery are usually preferable, and those grown in the "open," like the seedlings so often found along fences, are better than any taken from thick woods, both from the difficulty of getting ample bottom out from the network of forest roots, and because trees grown in dense shade often pine in the full sunshine.

For Arbor Day work, have every thing ready beforehand. Select some one as foreman, to have the oversight in procuring and planting the trees. Spread some four inches of good soil in the ample hole. Set the tree about three inches lower than it stood before, spread its roots carefully in all directions as they grew, without bending or cramping even the longest. Churn the tree gently while rich, pulverized soil is thrown upon the roots, working it around them with the hand, so that no empty spaces be left; dashing water on the roots, to secure their closest embrace by the soil; tread the earth firmly about the roots; cover the whole with a little loose earth, to prevent the surface from baking; leave the soil around the tree a little below the general level, so as not to shed, but hold, the water in showers; and *mulch freely* with straw, leaves, or chip dirt. Never behead trees. If the roots are few and the limbs many or long, head down the branches a little and shorten the more when the roots are few and short. When trees have been out of the ground for some days, "puddle" the roots, soaking them for some two hours in mud paste, thick as paint (a puddle of rich, mellow soil being easily made), keeping the tops dry. Out-buildings of school-houses may be screened with evergreens, such as Norway spruce, hemlock, or arbor vitæ. All such minute details can be easily arranged on Arbor Day, when many hands make light work.

One of the educating forces of Arbor Day begins when children are thus led to plant not only trees, but tree-seeds, acorns, nuts, drupe-stones or pits, and then to observe the wonderful miracles which the tree-life *they have started* is working out before them. What interest and profit, what growth of mind and heart, they will gain as they watch the mysterious forces of these living germs, their marvelous assimilating power carrying on such a curious chemistry in their underground laboratory, linked with the mysterious apparatus of the leaves above, transforming coarse earth and even offensive filth into living forms of surpassing beauty and fragrance. It is something for a child to drop such a germ in the earth, and to justly feel and know that he has made a lasting contribution to the natural beauty around him. There is nothing more ennobling than such consciousness of doing something for future generations, which may prove a growing benefaction in coming years, a better monument than any in bronze or marble. The trees which children plant around the homestead and watch from seed to shoot. from bud to limb, and from flower to fruit, will be increasingly prized with a sentiment of companionship and almost of kinship as they grow into living memorials of happy, youthful days. Thus the educating influences of Arbor Day will go on and manifest themselves more and more as the years go by, especially to all who apply Dr. Holmes' advice, and "make trees monuments of history and character."

Arbor Day should be so observed as to develop a stronger State sentiment. We underrate the value of that healthful town and State pride, which has always characterized the greatest and best of men. We need to be jealous of the good name of our State, and to feel with an eminent son of Connecticut that, "The man who does not wish to love and honor the town and State in which he and his children were born, has no heart in his bosom." It ought to be our ambition to make Connecticut one of the most beautiful States in the Union. With rare natural attractions along our sea coast, already closely dotted with choice and growing seaside resorts; with our rivers, valleys, lakes, hills, and mountains, Connecticut has a variety of charming scenery seldom surpassed within any equal area. Dr. Bushnell, with his keen observation and love of rural scenery, was wont to say: "No part of our country between the two oceans is susceptible of greater external beauty than Connecticut." Said another eminent citizen of Connecticut, after residing twenty years in Great Britain: "England in its natural features is not comparable to Connecticut in wide variety of the picturesque and romantic."

How would our State be transformed if our citizens, duly appreciating our natural advantages, should be stimulated to make real these grand possibilities. Aside from the elevating influence thus exerted on our homes and social life and character, such improvements would attract still larger numbers of desirable and wealthy residents from New York city and remoter points in quest of summer homes, or permanent abodes in the country. The experience of many Connecticut towns, like those along Long Island Sound, clearly proves that wise improvements pay in many ways, and that a good name tends to enrich a town and a State as well as an individual.

Mr. S. S. **West** of Columbia. May I ask the worthy gentleman, the apostle of tree-planting and forestry, what would be the expense of planting forest trees in order to come under the provisions of the law?

Prof. **Northrop.** It varies with the soil. On Cape Cod, where they have sand dunes, it costs some three or four dollars per acre, planting the seed where they are to grow. If you plant in rougher soil, where there is need of plowing and digging holes for the seed, of course the expense will be more.

Mr. **West.** What would it cost in my rocky, bushy pastura?

Prof. **Northrop.** The subject in hand is that of planting by the roadside. It would be difficult, of course, to say what the expense would be, but tree-planting costs comparatively little. Of course it may be said that we have already more forest trees growing than formerly, but a large part of the tracts supposed to be forests are occupied by comparatively worthless trees. If the subject were, as it is not, the economy of forest tree-planting, I should say that there are very many farms where there are little strips which are practically useless, and if each farmer should utilize those little strips here and there, rocky ledges and the like, they would add beauty to the farm and ultimately utility. I understand from Mr. Van Deusen, who I think is present, that his one or two hundred acres of trees at the Shaker Village at Enfield, which are now stately pines, have paid, at their present market value, the interest on the land, and the cost of planting. Mr. Van Deusen regards that as a most valuable investment.

Mr. **West**. I want to say, on this matter of tree-planting by the roadside, that there is no greater farm waste than shading your farms by useless trees. (Applause.) I supposed that I stood single-handed and alone in this matter. I am opposed to this indiscriminate setting out of trees by the roadside. Suppose I have a plot of land of ten acres, forty rods by the side of the road, and my neighbor on each side of me has forty rods by the roadside. I think I must have these large maple trees by the side of the road for the benefit of the public. Don't I need them just as much by the side of my lane for the comfort of my man who drives the cows to pasture? My neighbor, stimulated by this idea that we must have picturesque trees growing by the side of the road, leaves his trees growing by that field and lane. The roots of those trees penetrate into the soil from three to four rods, exhaust its fertility, and shade the land. Gentlemen, as practical farmers, we cannot afford to shade our land.

When I went on my farm, which had been in the family of my wife over a century, I found several apple trees and I let them grow up and got them into bearing condition. Finally I began to cut them down, and I found that the land for agricultural purposes was worth more than the fruit, and there is not a tree in the lot at this time. I found it for my interest to cultivate crops instead of cultivating those apple trees. Put your shade trees around your house, if you will, but not in your fields. I think we have too many shade trees around some of our dwellings; we make them dark, cold, and dreary. It is one of the growing evils of farming in the State of Connecticut that we are permitting these trees to grow in every corner of our land and around every fence, and they make our farming land look hideous. Cut them down! (Applause.)

Mr. **Hale**. I am sorry to hear in a meeting of Connecticut farmers this applause to a man who abuses the beautiful shade trees upon our highways. (Hearty applause.) I thank you for your greater applause on the other side. I am willing to take it for granted it is all right and I will not make the speech I was going to.

The quartette again favored the audience with some excellent music.

The **Chairman**. I take pleasure in introducing a gentleman whom you have always been delighted to hear; a man who is original in his presentation of the subject with which he deals, who has been progressive, and whom I am sure you will be glad to hear again. It is my pleasure to introduce Mr. **Olcott**, who is known to you all through the "Courant." Applause.)

## CONNECTICUT ROAD-MAKING.

By J. B. Olcott.

*Mr. Chairman:*

To call your attention to anything so sinful as common-road-making, with Christmas close by, and to fetch a parcel of pictures to this well-stocked market, requires what some may think a good deal of cheek. But this is a matter of opinion, which is constantly changing, like frost in the ground. Now it holds us up, and now, warmed from above or below, it lets us slump through suddenly. Public opinion is to be respected in its temporary way, but only for the young, in whom is our hope; need we say, that for lasting reputation it is as poor a foundation as frost is for permanent roads.

Roads are treated now, as a rather exclusive "industry," to be let to favored parties and individuals (who will pretend to do them cheapest), for what they can make out of them, and out of the public.

We act as if we thought road-menders, like jurymen and commissioners, must not know much of the case in hand, and that unbiased strangers must be selected to pick the stones from our highways and toss them upon the side-walks — if any are left to us — or into our mowing lots.

At such a juncture in road-affairs, we require spot knowledge and local criticisms, with plans for amendment, rather than formal drafts upon volumes of authority.

At the risk of saying something of "a leveling tendency" — which is what we need in road-making — I will drop a word right here, about equality. In our little games, we are continually calling men to pay the same ante we do, when our pots are a thousand times bigger than theirs are.

Current views about the equality of man have been very much modified during recent years. People who are not obliged to carry farm details constantly in mind may have forgotten, that if we give the swine the range of the farm-yard, with shackling enclosures, as some artists picture them, so that an enterprising pig sharpened by hunger and finding a gap in the fence, can draw extra nourishment from the cows when they are lying down and not minding — differences in growth will appear, surpassing any possible differences in breed. We have seen this proven in the same family. Buyers, who judge chiefly by the size of things are attracted by the biggest suckling, and frequently find to their sorrow, when taken from his extra keep the big pig don't thrive as well as they expected. It scarcely need be said here — except to have it known that we all understand it — that our legal fences (made and provided) have within a generation been decidedly favorable to the enterprising pig.

To fill the bill of what is wanted now, this paper, and especially the discussion following it, should make every one of us feel that we have gained a hundred dollars in spot knowledge about road-making. Spot knowledge, I may need to explain, shows us what to do next. One of the great beauties of a farmer's meeting, however, is, that we don't have to own to it when we learn anything.

Stalwart road-makers here present should understand, that, considering the size of my subject, I mean to be unusually short — touching but a few items in our present predicament, leaving others to fill in the gaps among my patches and add to their finish, as has been too often and too long the time-honored method of road-menders, who rarely perfect anything, and whom nothing but the grave-digger effectually stops.

Had the Indians been strong enough to hem in the first white settlements, or if our forefathers could have so governed themselves, as to have built, and farmed new land no faster and no farther than they made solid roads through it, convenient for social and business purposes, we, their descendants, would be much better off than we are to-day, and would have a better notion of perfect roads.

Those who think they know mankind pretty well, may suggest, that in such a case, first-rate roads, by which their enemies could get at them, might have been fatal to the first settlers, just escaped from difficulties in the old country.

It is doubtless, true, that many times in the world's history, the seeds of civilizations have been protected, under God's providence, by wretched roads. In the course of my travels over our beloved State, I have found, — Mr. Chairman — places, which seemed to me to be depending, chiefly, on that kind of protection. I am the last man, to deny its validity, considering how the State has been harried and distressed, by all sorts of cheating agencies, from flowage parties up to the tar roofers. In all our road talk and road action, let us never forget that poor roads and wretched streets may cover both good and evil from antagonistic forces.

But if our sires had possessed the wit, skill, self command, energy, and determination to make solid roads in the first place, as fast as they farmed land, and built houses, schools, and churches, they must at the same time have had the pluck to defend them. We can't imagine a community with the courage to make its paths straight, in every sense of the word, to be without the power to maintain them against all comers.

After the fashion of their day, and according to the means and necessities of, their time, our sires did build solid and well, till a blast of steam upset all previous calculations, and produced that right under our noses, which our fathers declared ill-governed broad roads lead to, and Colonel What's-his-name says don't exist at all!

Right here, perhaps, some friend, with paying stock in his possession, and no grade-crossings to be taxed for abolishing within miles and miles of his property, wants me to admit that we, the present grey-haired generation, have done far better in our time than our fathers did in their time. That railroads are common roads in this commonwealth, and our practical salvation to-day. I'm willing to say it for him, with a perhaps — with many ifs, for

I believe railways are among the grand experiments of this generation. Our railway bills and accounts are not all in, however. We haven't paid for the first cotton-gin, yet, Mr. Chairman!

Do the boomers of modern improvements ever think how serenely the common people, who live for ever and ever, look at their speculations? One wise old woman, remembering when turnpike companies were playing hob, and making the earth tremble with their exploits in rapid transportation, said at first, she would never ride in one of their coaches. But she did, and liked it. When the great canal business got to tearing the world up, she ridiculed the idea of her having anything to do with it, but after sailing in a canal-boat, and knitting two pairs of socks on it, she declared that was living and traveling together. When the locomotive engine began to thunder and lighten past her house, she thought surely she would never ride after that thing, but in the course of time she did, and called it a very quick way of going. As the telegraph poles went up she vowed she wouldn't ride on those wires, and up to this time she hasn't. Please mark, however, the cool way in which she speaks of our tremendous doings! Looking out over her spectacles, with clear, bright eyes for the future, she evidently considers them unreal, shifting, and temporary. None of those contrivances happened to hit her household badly, and if her children like to play with new fangled things, better than they do with horses, oxen, and carts, perhaps it is just as well, as long as they do no harm. Thus, we may imagine, an eternal God looks at the world with infinite patience!

It will be a pleasure for me to admit all good possible for railways, while I beg farmers and every well-wisher of the State to mind what they are doing. We must understand our railway system (if it has any, beyond draining the land into the sea, while it is consuming twenty-five to fifty-million acres of timber yearly)—before we can have any settled plans for *common* common-roads.

Have we got railways enough yet? is a question the whole State is asking. The standing army of railway builders and promoters in our midst, will say *No*, every time they run out of a job. That must be expected. And every thriving neighborhood will have a few elderly, fore-handed people, who are thinking they would get more enjoyment out of the remains of their lives, if a new railway were to run by their doors. These people are willing, on the average, to sink five hundred dollars to get it.

So, likewise, many lonesome farmers, tired of their old conditions, are hoping that by some chance, a railway will cross their barren fields, or go through some dark hollow, so they can hear the engine hoot and see the smoke and steam of it in their too familiar landscapes, before their toes are turned to the roots of an andropogon!

That is the way we are thinking now, Mr. Chairman. All easy money goes by railway, while hard money is too often fretted out over sand, mud, and stony roads — up and down hill for nothing — without much thought of making them permanently better. Find me, if you can, one, well-to-do, elder or younger person, who wishes to sink five hundred dollars for their own comfort in a good public wagon-road! That is the kind of people we are looking for. Our comfort-seeking people are looking some other way for comfort. To a summer in Europe, or a winter in California — or even towards some obscure arrangement for producing comfort in another world — forgetting that the Kingdom of Heaven is at hand!

Should the common people get the idea into their heads — and they are liable to — that we must have some better ordinary traveling — that railways, which land us three feet deep in the mud and mire miles from home, don't amount to much; that with good roads, a summer's jaunt or a winter's tour can be made just as pleasant in our State as anywhere in the world; that Connecticut is an unexplored country to most of our traveling people — especially to our governors; and that we won't uphold anyone longer in neglecting it, then, of course, the fur would have to fly.

All our directors, who are in the habit of telling people how to spend their money, and often showing farmers how never to get it back again, will be in a great flurry, and I am afraid, unless we begin at the right end of the work, some very foolish things will be done.

We speculators, trained at agricultural fairs, think the world is lively as long as we are getting premiums. We manage the people by studying their weakest wants and then rush them under bonds and mortgages. In the consequent excitement, many are ruined, but this makes all sorts of "business" lively for the crafts which thrive by disasters to ordinarily stable people.

Short bits of road, leading nowhere in particular, will find friends enough to boom them, give local contractors a job, and exhaust the spurt of patriotic feeling, without general benefit or permanent good ensuing.

To make our roads wisely, we need a big lesson in geography. Nothing less than a survey of the State will give this, so as to guard against surprises, and show every body where trunk lines of wagon roads should run. This might frighten railway people a little, at first, but would give trusty engineers something to do. The inevitable changes following — settled by everlasting gravity — would come so slowly as to hurt nobody. With the topography of the State — every hill, valley, and stream in it, plainly to be seen at the capitol, and a bit of the same in each town hall, we need n't be wasting time while some local politician is showing in freemen's meeting, on the palm of his hand, which road (he is personally interested in) should be turnpiked and hardened. The people will know without him. Some of our military energy might be sent into the field for a few summer and winter engineering campaigns in surveying the State.

For some years, now, we have been developing a mania for transportation. We have acted as if travel improves our victuals, as our fathers used to think travel improved their drinks. Railways became so demented with insane transports, that they have actually been charging less for a long than a short haul, and lazy employees were just now figuring that it costs more to stop a train than it does to run it. According to this calculation true economy would lead us to load the cars and keep them going as long as they will hang together!

But what shall we say of this deadly flux of over-transportation upon agricultural peoples, when English lion and Russian bear join the American eagle in carnivorous convention to pick the bones of farmers around the world, with feverish and unnatural commerce, for the supposed benefit of enormously over-grown municipalities? Why should not the cars run crazy, while there is no growing system of common roads to feed them and furnish pleasant stopping-places?

The idea of surveying the State for better country roads is an old one. That this is being done all the while for corporative interests does not relieve small land-owners from their plain duty in the matter. Cities, I think, were never so willing to consider such a thing. Perhaps taxes lie better for them, and out-door commissions are coming in fashion. Cities begin to feel, as never before, that crowded populations bring responsibility and risk; that the country about them is of considerable importance to their welfare, even with the fullest railway service. To guard against accidents and sudden emergencies, they would be willing to see better roads throughout the State, put in the way of being laid down where they should be. It costs no more to build a city street a hundred miles long in one general direction, than if the street ran round and round in the present city method, constantly tangled and getting into snarls.

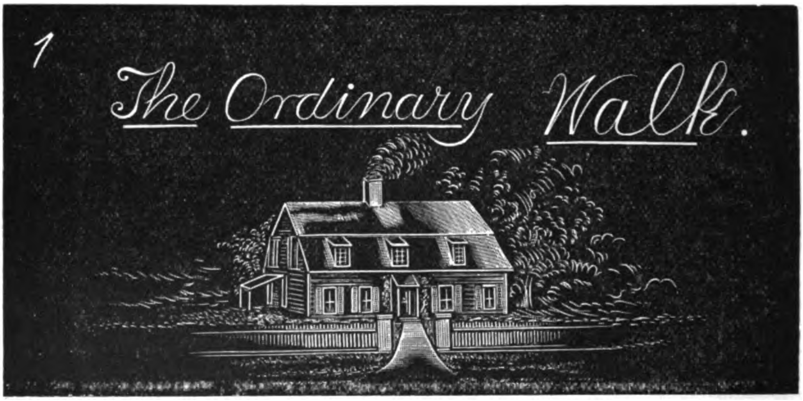
The real, lasting interest of railways consists, however, when we fairly get to it, in distributing population happily, rather than in crowding it unduly in cities This will presently appear plain to everybody. The idea of railways being run through the woods, or an unfriendly country, between happy cities, is not entertained, at present, by those who justly apprehend the real nature of human nature. "Love," says the Grange Ritual "is the only enduring power."

So much may be said in general respecting Connecticut roads.

Now, if you please, Mr. Chairman, we will descend to particulars. Unless we fill in the gaunt skeleton of steam road-ways, with all that belongs to local prosperity and happiness — unless we make our paths straight and the land safe and beautiful for children, women, all conditions of men and our domestic animals, then our grand experiment with steam transportation, will prove the biggest humbug and folly recorded in history since the financial crash at Babel. The confusion of tongues by that failure was nothing to the confounding din at the present time of our ten thousand thousand "newspaper echoes." Hanging a few of the prominent citizens of Chicago will not help matters. We must repent and become as little children before the mighty work we have laid out for the rising generation, or it had better never have been born.

Let us begin making our paths straight at our doors, if you please. If we are doing foolish things there, we may be able to see that we are doing silly things in many places.

Footpaths, properly made, being models in miniature of roads, I have often wondered how and why the dug-out paths around our houses were first constructed. There are reasons enough, such as they are. The good wife wants a path of the kind she's seen made by some gardener — gardeners offer fearful temptations to sin since the time of the first eminent pomologist — and the husband is willing, if he must, to cut some turf for his pig-pen. The shallow ditches, we call paths — straight lengthwise and very uneven crosswise, were often made in that way, no doubt. Whether in town or country first, I am unable to decide, since the devil of bad ditches is so prevalent everywhere, and the evil that is but stinted in the country blooms freely with hot city treatment. Whenever we begin to put on style in walks we are very apt to do it in that way. The pigs enjoy the turf, and the good-wife enjoys the smell of fresh earth in spring, while barefoot children are delighted to trample hard the soft rootlets in the fine subsoil.



But this ditch requires constant rebottoming with something. It collects water from the surrounding land and in winter often presents a surface of glare ice. An excellent old lady used to tell a story about sliding in one of those deep paths. She was a stout person, built according to that substantial pattern which does not lower very much in a sitting posture, and was in a fearful hurry to catch the passing omnibus. Not minding the ice sufficiently, her shoes slipped forward at the door-step, and so she launched, majestically, sitting upon the ice, down into the street, to the great admiration of the driver and a load of anxious passengers, watching how cleverly she sailed between the gateposts.

In the scene of this incident our artist has left to our imaginations the most touching part of the story, as unbecoming the gravity of a State paper. On the sunken walks of the Capitol — walks that a regiment of track-cleaners can't keep free from ice in winter — I have seen the heels of three legislators, or members of the lobby, in the air at once. Our fondness for these path-ditches must have deeper roots than I have mentioned, or it would not be so persistent. Possibly, it is a rudimentary survival of the moats and ditches of the feudal ages. Or it might have descended from the small gardening of our old country ancestors, where the holdings of land were often very small, and it may have been a matter of policy to sink the legs of the observer to magnify the extent of the grounds. In cities, where houses are so pinched in the row that you can't get a tooth-pick between them and are more liable to decay so, gutter-walks may be indispensable for surface drainage. In the suburbs, also, where proprietors have plenty of money to vie with their neighbors in extravagance, it may be handy to have walks and drives dug out and plainly indicated, to set tramp gardeners at work in without loss of time, who have run from apprenticeships abroad before they have completed their education. Most of these gutter-walks are sheer nonsense, come to us by aping or inheritance without due thought of the situation. They might come by copying the worn-out work of old masters, once built above the surface, as our artist has shown how to do. Worn out by the trimming, hoeing, raking and shoveling of the ignorant gardeners aforesaid, in their sorry efforts to magnify their offices, or to make places for sham workers of the same foolish and crafty pattern.

Our cross-sections here are as if a card of ginger bread was broken in two, so you can see by the edges what the inside is made of.

Bungling with cobble-stone and gravel has greatly served to develop tar and asphalt walks — also walks of brick or plank, and has thrown other money into stone pavements, it might have earned, with more faithful labor to make lasting paths of gravel.

People who will trim turf edges, in spite of me, will please notice that, in our sectional views, our artist does not dig perpendicular sides after earth for the pig-pen. That might let stones come at the edges to blunt the spade or turf-knife, when the time comes for trimming.

Pedestrians will not despise these path details. They apply, perfectly, to rural lanes as well as village streets, where dug-out walks are absurdly frequent, and a pernicious example to the roadmaker.

But I would teach gardeners and owners the futility of spending time and money on the raw and ugly edges of sward about their places. Straight edges of turf only please the plowman till he turns the next straight furrow. In a lawn those turf edges destroy all soft, homely harmonies and peaceful expression, making traps for friends and children — stumbling blocks for everybody.

Better flush private walks and roads with good gravel mixed with wood ashes, and bone dust, seed them thick with *Poa annua* and *Polygonum aviculare*, plants which incline to grow there, and keep them in order with the grass-scythe or lawn-mower. That is the end of weeding walks, and there is no fear of a hay crop or that the path won't always be there clean and dry if it is made right.

We want a surface around our houses where the children can play "I-spy-the-wolf" — without risking their necks — where a wheel-barrow or broad-tired cart can be run, or carriages either, when there is a joyful or solemn occasion in the family. I'm fond of grass, as some of you know, but I don't worship it too much to make any human use of it.

Relieve working gardeners of the present ruinous care of private gravel, and they will have more time to study the making of roads and their grass also, and how to keep weeds out of that. The present care of private roads is ruinous, because constant raking and hoeing expose the sunken surface ten times more to rain and wind which take all the clay out of it.

There is plenty of work in this world more useful and profitable every way, than raking gravel, if we put men in charge who know enough to point it out. Speaking of weeding grass, reminds me of the seven stalwart men who were weeding Bushnell Park, and doing less of it in a day than a child — a girl of fifteen years old — can be taught to do, with fit tools, before the men get there in the morning.

Now, Mr Chairman, if any economical country, or city man, thinks I am occupying the time of this board with "fancy work," let him enjoy his present ease, we shall have a change presently.

Perhaps, indeed, better foot-paths are what some of the men folks have been dunned for at home!

To be easily understood, here, we began with the little end of our subject; a part of it which women and children, if they please, are most interested in, and will be likely to understand.

We have pictured, in our sketches, coarse, sandy gravel for the chief filling of a walk. With less sand than a walk would bear, the same material will make a tolerable road for light uses. But don't let us forget that it takes stone and hard stone, too, to endure hardship in a highway.

With some misgivings — for I see city contractors are using it — I should say that coarse sand is good enough for the deep bottom filling and drainage of a foot-path. Coal ashes may answer just as well, but both materials will settle a good deal. An energetic person, who is having some of this work done, and chooses to see to it herself might, when the deep filling of sand or coal ashes is in place, in her walk or road, mount a steady horse the morning after a rain, and give the bottom stuffing, on which the integrity of the finished surface so much depends, a thorough trampling; or she may prefer to let a child do the riding, and still spare herself the pain of seeing a lazy day-laborer swinging a heavy maul over work that a horse will do so willingly.

In moist land the solid sand, or coal ashes, may come nearly level with the bordering turf of a foot-path, and then receive the upper crust of first rate gravel. But for hoofs and wheels, the inferior materials, must be kept two or three inches below the general level.

Good surface gravel for paths and roads, like a good horse, is of any color, though particular people often send long distances to get gravel to match their several complexions. From the white of oyster-shells — which must do a place proudly that was enriched by oysters — to softer greys, richer blacks, and warm yellows, reds and browns; we have a great variety of colors which must be handsome if they make a good road. Sea-pebbles, fit for the penances, bare-foot, of recreant road-contractors, have been hauled far inland to adorn front walks which nobody uses.

There's money in the dry details I am giving you. I knew a wealthy lady who married her gardener, because he took such excellent care of her roads. She had experienced no end of trouble with fellows rooting up her gravel, and when she found a good man she was determined to keep him. John told me afterwards, that these very hints I am giving you were what first helped him win the lady's affections.

Between you and me, I hate gravel walks and roads above ground, as they are usually constructed, to crunch, like murder under your feet and wheels, so you can't hear a word of what the person you are walking or riding with is saying, unless she screams at you.

I know a gentleman who has a nine or ten acre place, with narrow roads enough, that are very fair paths, but I don't recollect that he has any walks. His land is rather dry, and he thinks his turf good enough to walk on any where.

The best gravel surface will be only a trifle less hard in dry weather than stone.

Good gravel will be hard in the pit, takes hard judgment to recognize it every time, and hard digging to get it. It is heavy stuff to handle, and costs a dollar and perhaps twice that a load, handsomely delivered. Good gravel is cheap if we mind how we use it.

Without gravel or stone we can scarcely have a city or village, as we build them, though Chicago, without either to start with, did arrive by the extreme pressure of farm produce to the hanging of dynamiters! In 1872 I saw Chicago's roads being made of horse-manure! The solid work of old cities was literally cemented with human sweat and blood! Cities prate about economy, but according to their own standards, they never paid a mill on the dollar for the labor and life they cost the people, and the broad land which builds them. I mention this in legitimate connection with Connecticut roads, wherein the whole State must be considered, as every part of a town should be thought of duly in town councils. Those who differ with me now, are liable to be more agreeable shortly.

Considering the surface of gravel paths and likewise of roads, brings us to what is called binding material. Clay is the base of that, generally speaking. Some geologist might speak more by the card, as to that matter than I can, and a thoughtful chemist experienced in earths, might help us greatly. In several instances, in my own experience, I have got out of scrapes, by adding a very little clay to gravel which had none of its own, and yielded little by wearing. There are gravels which yield too much clay, to make mud, or be winnowed as dust into people's windows. Some road-menders deserve burying in the clay-pits they have made in the road. It is not only foot-pads and horsemen who rob on the highway — shameless road-menders do it!

The trick of using clay neatly I learned of an old lady who always had a nice, hard, flush walk to her door. She gave it a sprinkle of fine gravel just before winter, and dusted not more than a pint of pure, pulverized clay to every three or four square yards of surface. Then she covered the entire walk, snug, with leaves. She argued that leaves were good enough for muddy feet to come towards her house on, and said they saved foot-mats, scrapers, and a great deal of dirt indoors, besides protecting her walk from washing all winter. This idea is worth the price of four such papers as this to the comfort of a household.

Leaves make a silent, soft and most agreeable walk. I know several nice families who are enlarging upon this plan, year after year, as a winter luxury, spreading the leaves, ready-raked in piles, when they are wet and during rainy weather; using leaves on their private roads, also, greatly to their satisfaction. Leaves give protection and comfort on rounding earthern paths or roads as well as gravel ones. But, mind, I beg, that leaves might add to the filth of dug-out paths or roads.

The right surfacing of either roads or walks is all the same in principle. The top is usually all we think about, when we are walking or riding. We rarely trouble ourselves — more's the pity — about what is deep down under us, so we get along smoothly. In some of its phases, this surfacing business — the upper crust, so to speak, always to be supported under a wise government by what is below — is a new subject, unhackneyed by writers, untouched by cyclopedias. We have been so busy with machines and fertilizers, that I fear the graduates of our agricultural funds don't know how to prevent the boiling up of the subsoil through their superficial work — don't know half-clay rock and hard pan from macadam. Some pretend to think agriculture has nothing to do with road-making. Prof. Storer gives "road-mending" as one of his running titles — enough perhaps for his first edition. Loudon set a better British example for Boston, long ago. Storer should have given us the chemistry of road-mending, but he lacks funds. probably, like all the rest of us. Dr. Fernow of the Department of Agriculture, leads off in his first Forestry *Bulletin*, in a grand lesson in economy for railroads, such as a green railway man may well ponder.

I saw some frightful road-making at Massachusetts Agricultural College, done, I was told, under the personal supervision of its former president. The work looked like some of our worst mixtures of muck and gravel on the east side of the river.

Mr. Macadam was a strenuous advocate of broken stone. It is understood that he came over here, and got his mind to working good — I suspect he studied the nature of some of our gravel knolls, where the wheeling was always first-rate — and then went home and set the old women and children of England to breaking stone, to imitate the composition of natural gravel roads. Men were above it, I reckon, as they are in this country. This was what lifted British go-carts out of their ruts.

A few farmers and good road-menders, here and there, know and a bright mason or mortar-man, will readily guess, that the first set, or uniting of any earth, gravel, or small stone used in road-making, like the first set or union of lime or cement mortar, is the best. The successful roadman, like the skillful mason, or plasterer, has very short stories to tell, when his materials, tempered just right, will spoil on his hands unless he quickly gets them together solid. One who does not understand this might think either of these parties crazy at such a time, almost, when they are only inspired by the critical condition of their work, with a holy zeal for business.

How long do you suppose a boss-mason would keep a hand who was continually leaving his line of brick, strewed with quick mortar, and his tub like a sloven, to run to see a man round the corner ? Just as long as we ought to keep a road-maker in salt who spreads a long line of any fresh material, impeding travel on the people's highroad, and leaves it loose and rough to spoil and waste with dry weather, in lack of a finishing stroke.

Some countrymen, not very far back, may listen to me now, if they please ; but, take notice, that I am not objecting to the road-mender a town elects to see far enough ahead, who will turn out a month or two before hand and plow the tough grass and bushy gutters, that he will by and by wish to turn upon the road, and have the mellow loam work down fine without trouble, or producing a sort of a pig-pen finish with sods. No, Mr. Chairman, that man is getting to be a pretty scarce Christian. We need to propagate his kind.

A good road-maker will no more leave earth and gravel-work half finished, to waste, past redemption, in our frequent dry seasons, than a plasterer will leave his work, or the cook will neglect her biscuit, just ready for the oven. The road-maker's business, in short, is to make better wheeling, or let the road alone.

Where ignorant bosses and sub-bosses are in power we are apt to engender a species of truculent understrapper on the road, who can say of a poor job that he "knew it wouldn't be good for anything," but he "was told to do it in that way." When a man knows he's going to make the road worse he ought to start for home.

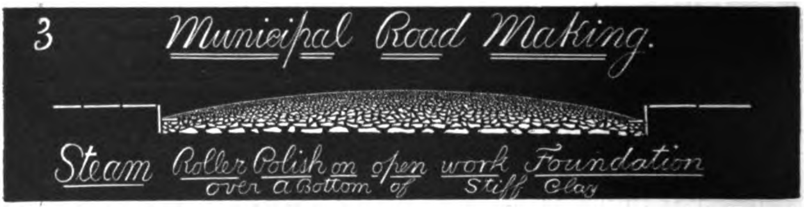
The first lesson I ever had in road-making came, when I was a very small boy, in a rather rare bank in my section, where an older lad showed me that a certain tough streak of earth, duly manipulated in our fingers, would make handsome mud pies, mimic biscuit and cakes, and if not shot too spitefully, after drying in the sun, very fair marbles. Later in life I used every pound of that streak of tough earth in polishing the surface of a stretch of newly graded sand road just there. That bit of childish experience set me to thinking, of course, but would not have been such precious spot knowledge to me on a road in Ireland, for instance. The stranger who can "move the most dirt" or gravel, often errs in laying it the wrong side up.

There are eternal reasons for waste by slow motions in the various and complex nature of highway materials. It can be truly said that every particle of earth has its own quality which needs to be understood by the road-maker.

Sandy loam, and all grades of loam, make a firmer road if they can be made solid while the materials are fresh and moist. Expert hands like to catch stiff loams and gravels, just after they have been shaken up by the winter's frost, so as to get the first knitting of the loosened material in its place on the highway.

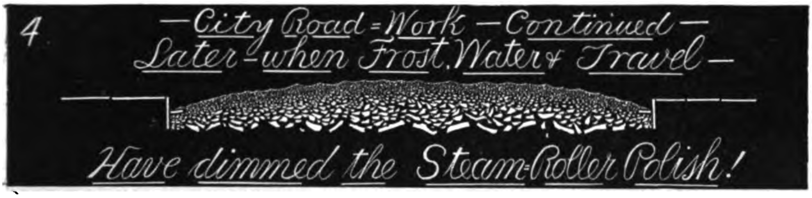
Gravel or sand examined under a magnifier, when newly taken from the pit, will show a ragged, burr surface and the marks of corrosion on most particles. The mason feels of his sand to see if you have brought him the true grit, and he likes to find it sharp between his thumb and fingers. It is the rough surface of every particle, which makes the whole bind and hang together when they are forced into solid contact in a highway. So every moment that these myriads of particles are allowed to lie loosely and be ground into powder, each one polishing itself and others by the tread of passing teams and wheels, every moment the chances are growing less of a solid road being made from that material. Yet miles and miles of that heedless and inexpert labor, adding insult to injury of the traveling public, are annually expended in this State. This showing of how the labor is wasted applies to foot-paths as well as wagon-roads. The poorer the material the quicker it should be consolidated — the better the material the more wicked the waste, when left loose.

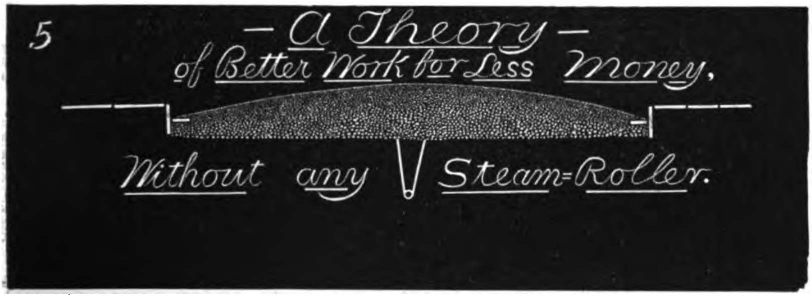
Some cities have a dirty trick of trying to bind the bogus macadam of their new streets with the mud and manure of their old ones. This is nasty and naughty, as well as dangerous. The greasy filth may be a stuffing, but is not proper binding for stone, filled as it is with vegetable matter. Slippery clay, or hard-pan, newly dug, can only be a nuisance, when applied in quantity to the best work; on the worst it cannot hide the botching, and only serves to aggravate the muddle on streets where clay may already be too plenty. Our artist has two or three pictures to show this.


3
Municipal Road Making.
Steam Roller Polish on open work Foundation
over a Bottom of Stiff Clay

Whether anarchy in road-making begins here or somewhere in the country, is rather hard to tell.

Please note the humbug of that loose foundation, drainage-layer of flat stone. Honeycomb is too sweet a name for it. Even with the next coat of smaller stones a lot of bridges and open work must remain and crevices be left, to be filled with clay from below, whenever water and frost sets the subsoil afloat. Those flat stones should be broken to furnish their own binding material! Macadam, if he were living, would cry out against any such work as that in his name! When the soil or mud from below gushes up to fill those chinks, the flat stones, under the crush of heavy wheels, must be tilted, setting the entire superstructure in motion, and rendering nugatory the fine finish of the steam road-roller. Whether a really perfect road can be made at a reasonable expense on any such tottling foundation may be doubted. I should prefer to regard a road thus built as so much dirty raw material, to be quarried and broken, free of cartage. Mr. Macadam found old England full of similar bad work and so amended it:


4
—City Road-Work—Continued—
Later—when Frost, Water & Travel—
Have dimmed the Steam-Roller Polish!


5
—A Theory—
of Better Work for Less Money,
Without any Steam-Roller.

Cartoon No. 4 shows how bottomless such jobs wear. Some cities have plenty of them. In 5 we see drainage and broken stone promise better results.

6
more municipal work.
A Busy Street.

Cartoon No. 6 is a street view, exhibiting labor enough to break the stone if fit tools were provided and the men would work. City macadam should be made water-tight, with fine broken stone, and rolled by cart wheels as hard as iron. The mud stuffing seems designed to make city roads porous, soft, and rather easy to pick holes in. Picking holes in the roads is growing a great city industry. There should be life insurance clerks enough in every modern city to see that the waste of mortality from old streets is not spread upon new ones. We can't expect much of health boards manned by those whose living would suffer if there were no sickness.

7
as it looks to a Horse!
Behemoth!
The Neglected Cart Wheel

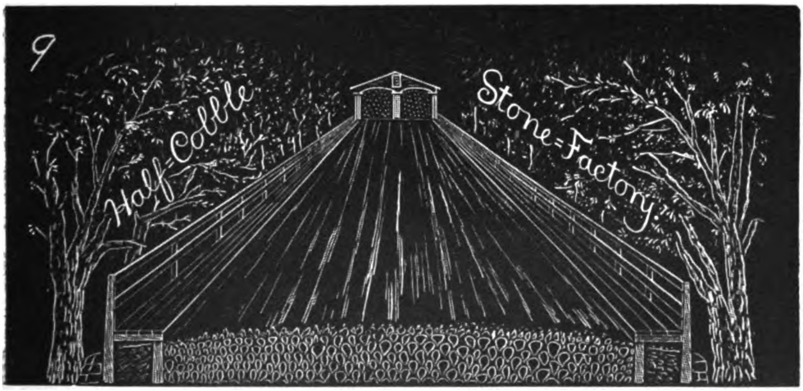
Cartoon No. 7 is a view of that behemoth, the steam-roller, as it looks to a horse. When used, on top of open-work foundations, it is a fraud — a cover for road anarchy. Its broad wheels span several of the bridges below, giving nothing like the searching pressure of a loaded truck wheel or coal team. Its boasted finish is

8
Corporation Stone-Hammers.
The Horrible Drawing Knife.
Scale 4½ inches to the foot
"Best One".
Hatchet
For Sale to Hartford County.

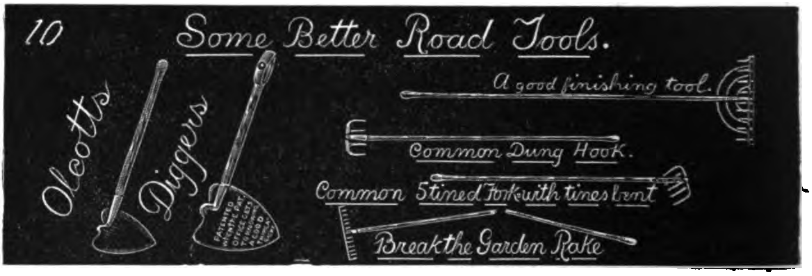
superficial and worthless, like that of a farm-roller on newly plowed ground. A more durable and perfect surface could be given by the teams delivering the stone, if they ran on six-inch tires, as all heavy-loaded vehicles in a city ought. Observe, also, the portrait of the neglected cart-wheel! Still — a broad-tired cart-wheel is only a "theory" unless we know how to use it.

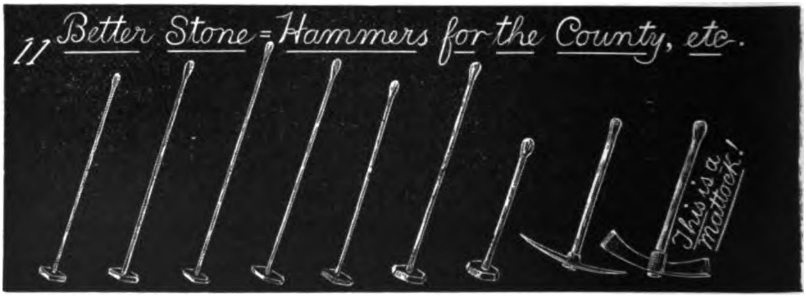
Stones, as they are "broke" on our roads, remind me of a little book entitled "English as She is Taught," in some schools. Bad roads and bad schools go together.

Cartoon No. 8 — shows the tools for breaking stones, as displayed in actual service by an ancient and honorable corporation, still in existence. What scared me was, that no one else appeared to notice them! Our artist portrays the honorable drawing knife, also, kept in constant use, fitting handles from the limbs of sappy maples, close by, and during the exploits of this corporation. The maple trees are left to our imagination. No doubt the hammers exist, among the assets of that company, a tangible evidence of these dark ages in road-making.

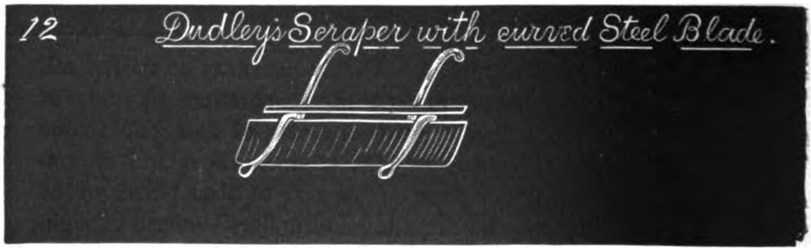


Cartoon No. 9 — indicates, faintly, the enormity of what I call the half-cobble stone-factory of the same corporation. Its mile of road represents costly layers, held for a rise, of half cobble-stone worn smooth on the top side by dint of horse-shoes and wagon-wheels. One investigator figures the cost of that polish to the people, at two hundred and fifty thousand dollars — cheap enough, if thereby the State learns better than to make stone roads in that way. Such notoriously bad jobs have their worst effect in making people dread stone roads, or any mention of the use of stone on a highway.

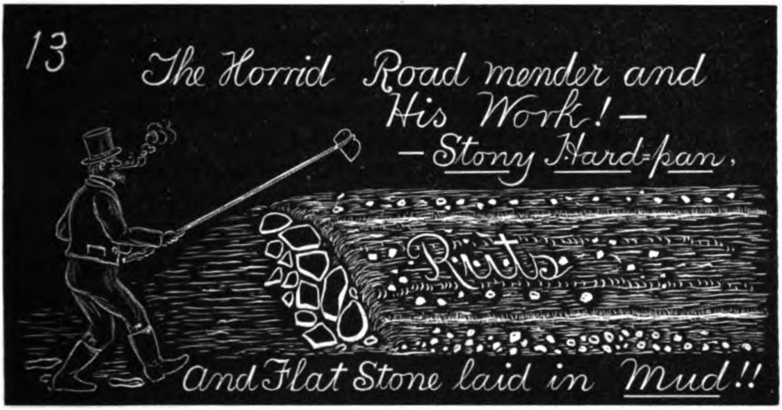


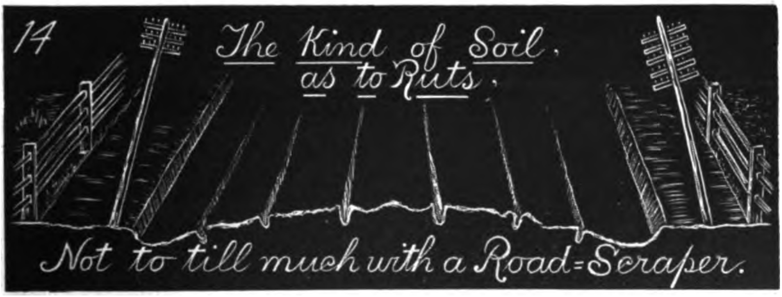

11
Better Stone=Hammers for the County, etc.
This is a Mattock!

Cartoons 10 and 11 attempt to show some better stone breaking and road tools, such as we can have as soon as we choose to order them. Tapering, springy hickory, with the root of the timber in the eye of the hammer, and with knobs on handles of suitable length and weight for different hands are what we want for cracking stone. With pleasant tools, breaking stone becomes a game of skill, an agreeable pastime, easier than tennis and safer than base ball. Garden rakes are no good in gravel-work, they take out too fine pebbles. A hay-rake is a better road tool. No. 12 shows rolled steel plate instead of plank for one of our best road tools.


12
Dudley's Scraper with curved Steel Blade.

Cartoon No. 13 exhibits the figure of the "horrid" road-mender *in propria personæ*. He's a hybrid — partly native and partly imported, I judge. Some critics think the pipe too long, others, that it compares well with the hoe handle. This picture is not, I think, applicable everywhere. His practical views of stone roads are shown by his arrangement of a few flat stones, and the deep ruts his teams are cutting through the stony hard-pan he is hauling to the bottom of his new work. This is road anarchy again, and he has evidently seen how things are done in town.


13
The Horrid Road mender and
His Work! –
– Stony Hard-pan.
Ruts
And Flat Stone laid in Mud!!

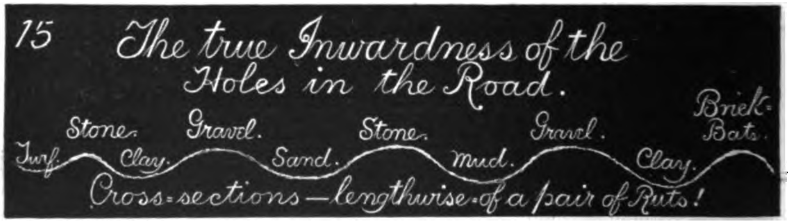

14
The Kind of Soil.
as to Ruts.
Not to till much with a Road-Scraper.

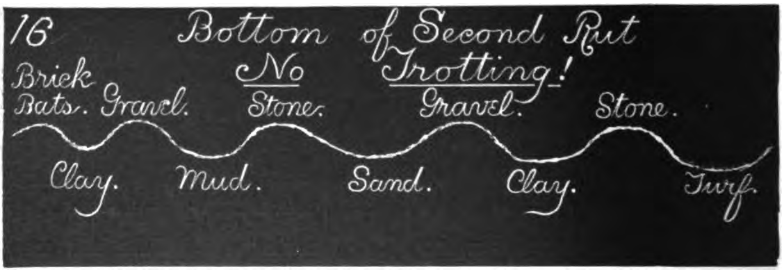
Cartoon No. 14 well presents by cross-section the kind of soil not to till with a road scraper. The particles and pebbles in it are worn round and smooth. The whole road-bed is just about fit to top dress a bush pasture. Please notice the lop-sided tracks for one horse carriages.

The only practical suggestion I care to give at this time for our terrible broad stretches of rich sandy mud, long subjected to road scraper tillage, is to split them lengthwise in two parts with a gutter, and seed one-half down to Connecticut River bents, thus growing tough sod to ride on in alternate rotation. These magnificent grasses were shown in town, here, in connection with Kansas mortgages. Thanks to Messrs. Robertson, loan agents, we have a few samples in the hall below.

My friends may laugh, if they please, but I make the suggestion in all seriousness. In the short time we have been testing these grasses at the Experiment Station, we have proven that one of them, *Panicum virgatum*, is a quick seeder. Their rooting qualities are well known to whoever has tried to plow or dig them. They are the lasting forage plants of Connecticut as well as of the prairies, and what is pat to my present use of them — I presume I can take out a patent on it — they gave a firm, springy road for the teams of our brethren who first settled those delectable western regions, besides furnishing hay and pasture for their stock. Farm anarchists destroy those native grasses.

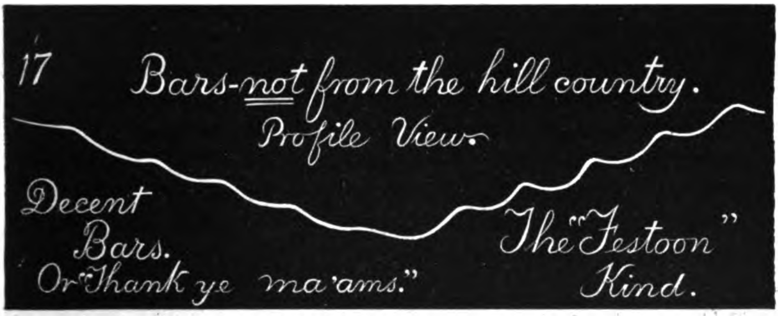
Our western friends may buy my patent — all rights reserved — and catch on to this idea of growing a grass plank road, before we do in Connecticut. A well-known gentleman and newspaper correspondent, writing from Illinois, has repeatedly said that the only remedy he could think of for roads of certain prairie muds was to build miles of sheds over them. He argued that this will keep





out water and frost, and lumber will last longer in a roof than in a plank road. Bents can be grown on the spot from seed, by paying my royalty.

Cartoons Nos. 15 and 16 explain the true inwardness of the frequent holes in the road we often find, where generations of careless road-menders have botched and patched it with every sort of earth and rubbish. Road material (*metal* is the better word which we have not yet grown to) — should be uniform, all of a kind, homogeneous. There are deep ruts, doubtless on Cape Cod, but they are of a regular depth in a homogeneous sand, and so far endurable. What we complain of is that all four of the wheels of our wagons are often running on different grades. This kind of a road, if a body tries to trot any, is apt to throw the child out of its mother's arms! We let our road-menders shake us enough to the mile to furnish assault-and-battery cases for a thousand police courts!

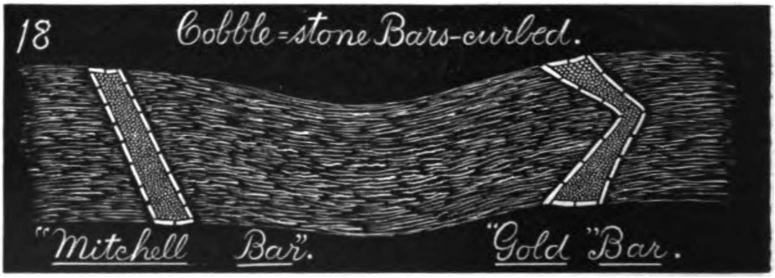


Cartoon No. 17 is a sketch, *not* from the hill country. Where people have fewest hills they know least how to manage them. Our artist pictures what she calls decent bars — also some of the festoon kind, which go about equally hard — up or down hill.

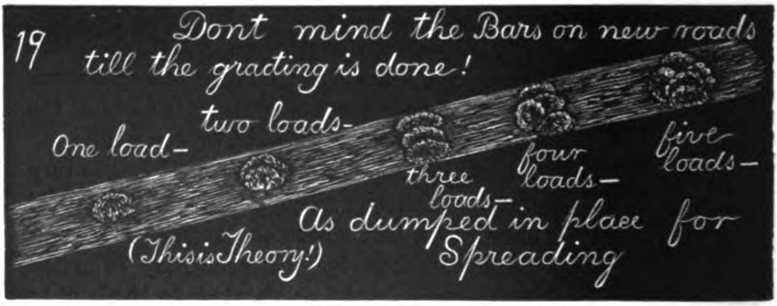
The object of a bar on a road is not to stop travel but to turn water. Some road-menders fail to realize this distinction. Not much height is required in a bar, where the road is kept well rounded, with diagonal depressions, leading each way from the center down to the gutters. A bar of earth needs to be about as long as it is wide, and it is a bad one that travelers feel much.

Roads where towns tax the land, but spend the money elsewhere, are often perennial disgraces, not worth a guide-board, yet the towns which utterly neglect a part of their highways often permit gross blunders on their main streets, in roguish attempts to absorb public funds and feed a centralized population. In low stages of farm mechanics, it is unsafe for a town to vote much money on its roads, till it is seen clearly what is going to be done with it. Poor roads seem to be kept open, in some places, like a beggar's sores, to get money. If mended permanently, somebody might loose a job.

Higher bounties in other employments attract labor that can see straight, and leave half blind men to mend roads.


18
Cobble=stone Bars-curbed.
"Mitchell Bar."
"Gold" Bar.

Cartoon 18 represents stone bars, one of which has been in the Annual Report. It is shown on the road at Cream Hill, as the cheapest bar in town. I found two of the other pattern in front of Edgewood, the result, probably, of Mr. Mitchell's nudging local authorities, who are apt to forget good things, unless some one speaks at the proper time for action.


19
Dont mind the Bars on new roads till the grading is done!
two loads-
One load-
four loads-
five loads-
three loads-
As dumped in place for Spreading
(This is Theory!)

Cartoon 19 shows how bars of any size may be applied to an earth road after the grading is done.

To be sure of a practical and pleasant paragraph in this paper we quote from Mr. Mitchell's "Rural Studies." He was writing of New England and Old England.

"At a considerable remove from towns, we frequently come upon some quiet streak of country road, charmingly bordered with a wild sylvan tangle of hickories, sumacs, brambles, cedars, and all festooned, perhaps, with the tendrils of the wild grape or the twining stems of bitter-sweet. Neither economy nor good taste command the removal of these, even when bordering cultivated fields, except (which rarely occurs) they harbor bad weeds to spread within the enclosure. Nay, in nine cases out of ten, they furnish a grateful shelter from the winds — a matter too little appreciated, as yet, either by fruit-growers or grain growers, and on the score of taste, no more charming contrast can be devised, than that of such wild profusion of growth with the neat and orderly array of crops beyond. I can recall no more delightful scenes in England, than certain ones in Devonshire, where, after strolling along some admirable bit of macadam, with high hedge rows on either side, sprinkled with primroses, and tasseled with nodding ferns, and wild with tangled thickets of bramble, I have with a leap broken through and seen beyond — so near to the road I could have tossed my hat into the field — such trim lines of emerald wheat, without ever a weed or a crook, as made the heart rejoice. The high hedge rows are indeed now being cut down throughout the best cultivated districts, but only for the economy of land, the surface occupied being needed. But while we have country roads from five to six rods wide, the same objection does not obtain with us. Observe, again, I beg, that I do not counsel the planting of any such road-side tangles, or, indeed, the sparing of them when *any better use can be made of the land.* I only plead for their continued presence in place of a rude, hurly-burly of stubs and harsh boulders, to which condition many farmers reduce them, and call it a judicious 'slicking up.'"

For the sake of Connecticut road-sides, the board of education might put that paragraph in a school reading book.

Cartoon No. 20 was done, in part, to remind road-makers to begin new gravel roads at the end nearest the gravel supply. It is poor gravel and bad work which makes no road for itself to ride over. Why should that most important natural bank, a town or neighborhood can have to draw upon, remain almost inaccessible in its approaches, or be barricaded with accumulations of rejected material — often the best — besides being used as a dumping-ground for private rubbish, waste, and garbage? The gravel supplies of a town should be a matter of liberal public provision and scrupulous care.

Here is also a showing of how to use the whole of an ordinary drift gravel bank, of fair quality, in making decent roads cheaply, where the fill is six to twelve inches or more, without costly assorting or screening. None of that for me. It takes all sizes of pebbles to make a good road as it does of people to make a good meeting. Build on the big ones. I should hate an audience of pure road-menders, or agricultural writers, say, as bad as I should screened and assorted pebbles, because I should know they wouldn't stick together without a good deal of pounding and breaking.

It is not good policy to ask shovelers to assort gravel and throw out stones much where rapid loading is desired. But a virtuous hatred of sand, or much clay, hard-pan, or loam, as bad for the job, and very injurious where quantities of either go together in any one load, can be instilled into the minds of workmen who have ever seen good roads, or are reasonable men. None others are worth having.

20
Begin your Road
at the end next to Gravel Pit!
It is Poor Gravel & Poor Work
That wont make its own Road!

The master of the work must be quick to see where the trouble is and one in spirit with his men and their task — whatever his clothes are. No "ship's cousin" need apply. (A "ship's cousin" is a relative, put on board to boss the ship and have no responsibility.) A teamster, unless he is old and disabled, or very young, which is no profit, should take his shovel quickly — any shovel — after setting his cart convenient for the constant shovelers, and should do his manful duty, never seeking the softest places for himself, but keeping a vigilant eye, the whiles, to the character of his load, so that it shall be a well-mixed sample of what the bank affords. A road-making teamster should be of so hearty and sincere a temper with horses or men that they will mind when he mentions a matter of business. The driver who can drop his load on the spot in the fill indicated by the point of a shovel, is worth dollars more a day than the fellow who is always three or four feet off.

Where the bank is high and cavings frequent, there is danger to life and limb, as well as to the quality of the road-stuff, which may be streaky and changing in the bank. As teams play like shuttles, weaving, vigilance, faithfulness, skill, and despatch will be required at both ends of the route. Yet the governor of New York tells farmers at a fair that labor on the road can't expect the wages of skilled mechanics. He's figuring on poor country roads — on stupidity — the kind that never owns a shovel — that don't care — that spreads gravel helter-skelter, big stones bulging, and never made good work in the world except as slaves, three or four to fill a man's place!

To make solid and smooth-wearing roads cheaply the gravel and stones must be assorted while laying it. This fabric is too heavy to be made in a distant factory and sold by the yard. It has to be done right at the people's doors, and is one of the few cash employments they have left. That is one reason why we make such a confounded muddle of it in some places where men have little else to do but go on the road.

With ten teams, well manned, hauling a quarter of a mile, and every cart with six-inch tires on, loads will come so fast that two first-rate men will be needed to fabricate the gravel. Toward noon or night, when everybody is figuring on getting done at once, a third or fourth hand may be needed to prevent confusion at the business end of the new road.

The depth of the fill may vary as the surface of the road should not, and this gives a chance in the deeper places to put loads of sand and big stones, perhaps, where they will do no harm. Clay, or hard-pan, in our climate, works up in road anarchy like a slow but sure sort of dynamite.

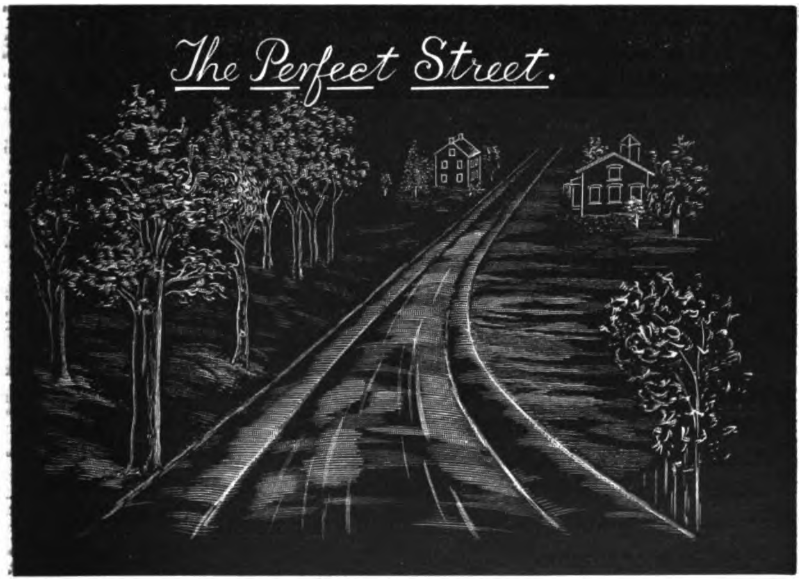
No two men will see exactly alike — which is fortunate in many respects; so there will be a difference in the judgment of teamsters as to the quality of gravel and corners and streaks in the bank which will furnish tip-top upper-crust. These points will surely be taken advantage of by a good manager, who will wish always to favor the surface of his road without making much stir about the different classes. He is such a good mixer that it is sometimes hard to tell him from a popular politician, except by one rule, the work of the latter is constantly breaking up, and the paltry politician loves to be doing his own bad work over again. But where a first-rate job is intended, two or three trusty teamsters out of the ten, will always be going for solider gravel (or a select load of rubbish to bury), and all the teamsters will be glad to do it, and the shovelers be glad to send them, making every day a day of judgment, when they see how the new work shines.

In good road-making, as in good society, we lay down the genuine aristocracy for the wheels of state to run on. Malefactions and counterfeits can give us no solid support. Pure sand is much better than clay for filling among heavy stones. Clay is a nuisance in the road-bed.

With four and five-tined pull-forks — the smaller working right after the other — it takes from three to five minutes to haul the big stones, and the smaller ones on top of them out of a load of gravel into the middle of the new road. It is easier than pulling out big potatoes down hill. What remains is safe to spread with a shovel, enough above grade to allow for the final settlement, coming like fate, with the trampling of loaded teams.

The assorting is made easy — and we really ought to have this idea patented, too (Adam and Eve never cared a cent about that apple till they were told how dear it was). The stones comb out easy, because every load of gravel is dumped above grade, on top of the verge of the fill. A light stick of timber may be needed in the beginning, to stop wheels with crushing loads on, till green teams and teamsters find out exactly what is expected of them every time. I'd rather teach horses than some men how to make a road.

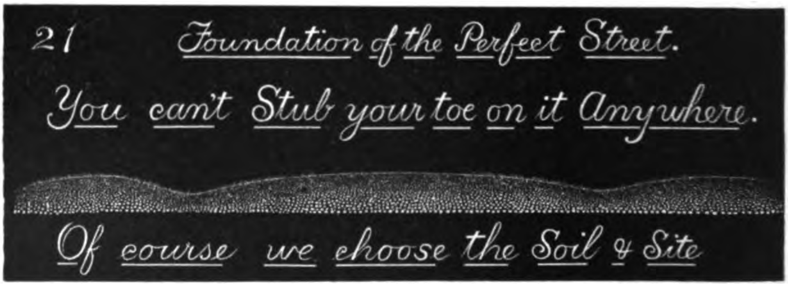
In good road-work, men have to do much, especially the busy shovelers. The women will be house-angels who get breakfast early, pack hearty and tasty dinners, and are always pleasant for men to get home to — tired, hungry, and wet, like enough, at night. Road-agents may need to have been right there, to understand that, without putting women on street boards. Teamsters will have to figure in driving more than they have been accustomed to, as I will show, presently. Bosses may need to tear around with patience, and those who pay the bills, and don't understand it all, may have their feelings hurt. Boards of agriculture, and audiences may find it rather tough listening to these particulars, but after all, it is the teams — the good oxen and horses, with their loads and wheels, which make the glorious roads I am describing. The man in a statue may have been a reprobate in his time, in some respects, but his horse was all right, and I wonder our image builders don't think enough of beef, if they don't care for work, to set up a brazen bullock or a pair of faithful working oxen somewhere.


The Perfect Street.

For going or coming, our teams travel over the new work, and are never to follow anybody's ruts. Teamsters understand, in the first place, that they 've got to, and take great pride in it, or lose their official heads. What are we breeding great, flat-footed horses for, except for this business ? The wheels roll the road as no steam-roller can pretend to do, so at noon or night, except for the last two or three rods, you can spin a top on it. It is as hard and smooth as it ever will or can be.

Gravel can't well be too stony for this class of work, with the big stones combed out of the four top inches, while small ones, plenty of hen's-egg size — the life of the road — are left to cover them and bear the trouble. So made, the road wears smooth, for years, without any lumps of stone protruding. It looks like an oval bed of rock in the highway, with scarcely a pebble showing, unless a stone gutter is needed. If that is so, we shape it of the spare stone we are handling, and fetch that too, right along under the cart-wheels. This grand idea is not patented.

But this is more fancy work, some will be thinking; and there are places in Connecticut where gravel is not to be had — where there is nothing but black or brown loam and rocks to make roads of. Here's Secretary Gold in pretty much that pickle, and expecting a hundred dollars' worth of spot knowledge for Cream Hill out of this paper. A man who is everlastingly particular, as he ought to be, about the fitness of his road clothing, may not be suited here, exactly. I believe in local measures, and seeing that roads grow according to the grace of every neighborhood. I never made but little road out of pure rocks, but I know it can be done if part of them can be broken, and I am perfectly willing to advise *him* how to proceed.


21
Foundation of the Perfect Street.
You can't Stub your toe on it Anywhere.
Of course we choose the Soil & Site

Get your road hammers ready; tell Collins Company you mean to make the fire fly, and want some special steel to do it with. What harm would it do if the Board of Agriculture, now it is come "of age," should effect so practical a thing as to introduce a set of road tools? or will it prefer to leave all that to Grange trading houses? Don't try to work in any old farm set of stone beetles, and look out for your handles! Now is the time to cut and rive the timber and have it seasoning, or send our drawings for the Collins people to work from. Talk with every man and woman you've got about the job beforehand, so as to raise enthusiasm against mud and dirt to the highest pitch. Get your eye on an old wall that is in the way, with a less proportion of hardheads than your farm averages. Choose an easy and short job, in the first place, to get your courage up. If there are any shale rock and brittle stones on your back lots, send for them. No matter how hard a stone is, if it breaks easy. Then get your stakes ready — sawed chestnut, three inches square — and stake out your road. How wide? I'm glad you asked me. A good road in your section needn't be so wide as it is long! countrymen should get their heads clear about that. Your whiffletrees always overhang the road! Land is so good up that way that not much is wasted in roads. Ten feet was the common Roman measure. Try a narrow gauge. Ten feet will do if we let a load of apple barrels or cheese boxes have it all. Eight feet wide and three feet deep in the center will hold some of your rocks, and perhaps be wide enough. This advice is quite as good, certainly, for many other parts of our State as it is for Cream Hill, where, if people would build more stone roads and less stone walls, I think they would be richer, unless poor roads come to be our cheapest protection against thieves and robbers!

We can be getting our tools and spot knowledge together, and learning our trades, while that topographic survey of the State is proceeding. Mr. Gold, and all the rest of us, need to have very clear views about which way to run our roads, so that Boston, Providence, and New York people can get to us. We need all the light there is on our old ocean bottoms, before we mites can co-operate as coral insects do.

In Cartoon No. 21 we have a glimpse of a street with a cross-section added, where there is great peace and quietness on the subject we are mulling over. Nice owners and gardeners are not compelled to rake gravel paths, driveways, or a portion of the streets in front of their lots twice a week, because all those places, favored by the natural formation in that vicinity, were built deep, dry and solid in the first place, and then seeded with the grasses and dwarf plants which readily grow in paths and roadways. Some gravels and some stones are richer in phosphoric acid and potash than some fertilizers we have had in market. The richest gravel, will, of course, make the greenest road.

This picture is a fancy sketch — a beautiful theory — but I have seen its main features reduced to practice, almost everywhere in my travels. Sensible gardeners turn the double sommerset about weeding walks without the least injury to their systems. To execute the entire plan, except in the matter of time, is as easy as rolling off a log. It will grow of itself when the women folks get their heads clear about the details, so closely is it allied to the soundest common sense.

It is not good for man to be alone, but a villager works in worse than solitude, while his wife and children or his neighbors, are careless of the good or bad example he is setting. To make harmony in a street it takes more than a single hand-organ. Master ideas must govern as in a band of music. Every performer on one of those what-d'ye-call-its — no matter how his cheeks stick out — has his eyes set on a bit of pasteboard, showing a plan for co-operative blowing. He may be four feet high and six feet round, he can be a walking maypole, as long as his clothes fit him, but he's got to follow the schedule on that bit of pasteboard, or he can't play the what-d'ye-call-it in a village band. Our western brethren understand this a great deal better than we do.

It is precisely so when ladies and gentlemen cast in their lots together to build another Garden of Eden along a country road. There may be liberty enough ; folks can't be exactly alike, and we all wish them unlike, with lovely variations, from house to house, for us to enjoy visiting them. Duplicate planting of yards, or buying of books, newspapers, or the same corky Baldwins, from one nurseryman or grocer, are extremely tedious to run the gauntlet of. But there must be a certain agreement concerning street walks, and the shape of the public road, or they will look like bedlam. The lines of roads or footpaths should flow like a stream without an eddy or ripple.

Town and municipal authorities may require to have their heads rasped thinner to appreciate these ideas, and the wives of local journalists may have to be affiliated at teas, dinners, etc., etc. When these conveniences do not exist,— or where they do even — the Church or the Grange may take a hand. One trouble I have hinted at before. Some very acute people are extremely near-sighted ; they carry a wall of fog around with them, and unless their attention is particularly called to it, and they get their long distance glasses on the landscape, they rarely take in the entire view as a fellow riding through their streets does, but see and enjoy merely what their title deeds cover. Hence it follows on hundreds of streets throughout the State, which might as well be all delightful, that the nicest private efforts only add to the confusion, as where performers in a band play separate tunes, till people of taste escape to the woods after harmony and peace.

For instance — on several streets I have in mind, certain residents are growing gutters of lawn-grass, fit for the New Jerusalem, with nice sod running close to the wheel-track, which need not be more than seven or eight feet wide. I have known a tender-hearted road-scraper to shrink, officially, from touching that sod, because it looked so beautiful, and wasn't in the way at all on the shoulders of the road! Had I seen him doing it I should have given him my last dollar.

Those streets show, also, a fair evolution of dry, clean, turf sidewalk, with an easy mowing-machine slope towards and across the gutter instead of curb-stones. Stone-gutters and curb-stones have a fearful pre-natal influence on some of us. We like to see them stick up or stick down as a sort of a magnificent multiplication of our boundary line-marks. Curb-stones are the rudimentary fortifications of ancient cities, breaking out in this new country — signs of the times when cities constantly fought with one another worse than Hartford and New Haven do now. In Boston, curb-stones have grown eighteen inches high, already, on this continent! It is better to sink those latent ramparts than to sink, ourselves, beneath the clammy legs of the "Old Man of the Sea." On the best part of Hillhouse avenue, New Haven, you will find the curb-stones nearly level with the street. We certainly don't need curb-stones on suburban and rural roads. Yet, on the same streets I am talking about, there are other residents, who take great pains to scour out their gutters — like the bottom of a clean barn-yard, just raked for scrapings — against banks of earth or turf, like small Chinese walls. These people, and others on those streets, have, evidently, curb-stones in mind, as the grand desideratum. They have never once seriously considered, probably, how society might rid herself, forever, of the semi-barbarous superfluity, in a great many places.

Duty compels me to say, here, that when we get ready with God (and the railways, perhaps) to let New Jerusalems grow in Connecticut, we shall not try the harmony in vice of throwing our slops on our neighbors, to make deadly enemies by scattering diseases. There will be no sewer-pipes to leak in our perfect street, because we have seen that the hard-heartedness — the monsters produced by that item of a false civilization, are worse than all the savages we ever had to deal with.

Trees, around broad sunny spaces, will be plenty in our perfect street, because we like to see them, though not afraid to cut one when it is really in the way. We love the shade of trees in summer, we need their roots to drain our subsoil, and we want their leaves in the fall to carpet our rotund paths and roads along the quiet and peaceful aisles of our possible Utopia.

In the case of such a street as we are planning, the road-scraper will not be wanted to till broad surfaces of mud or dust for us. So these machines may be expected to growl a little, as they depart for regions which have not yet outgrown them. Repairs will be light — very light — when tax-payers see that the mending of roads thoroughly built in the first place, is one of the smallest chores of a life-time. The little new material required may be carted, of exactly the kind necessary, and put precisely where it is wanted. We may haul gravel from the Rocky Mountains, then, for the money we now fool away in raising *sheol.* With so little surface exposed to washing, grass gutters and the shoulders of the road will rise very slowly. Dust and mud will have become obsolete terms along our common-sense-street. The worst that can possibly happen to it, is, that in place of weekly gutter-scrapings and perennial filth and dishability, we may, once in fifteen or twenty years, have a splendid lot of fine turf to sell to our neighborhoods that wish to follow our example, while we reseed our street slopes for a better sward.

Now — at the risk of your thinking me an agent for a factory — let me impress your minds for one moment with the glory of the broad-tired cart-wheel for this class of work. All the slow improvements of creation suggested here depend upon it. The old deacon's small potato felloes that he ordered a quarter of an inch smaller, so as to play loose, inside his neighbor's frozen ruts, ought to be played out, in Connecticut, by this time, but they are not. We have a lot of road-menders in this State, Mr. Chairman, who are not ashamed to lay down onion beds, for mellowness, in the highway, made of all sorts of stuff, which they can't pull their own vehicles through, loaded, and never, if they can help it, drive on with empty wagons. Yet they draw their pay with brazen faces, and expect the traveling public to wallow through their artificial quagmires.

How can we expect civil service reform in high places, while with outrageously false pretences, we are continually taking the people's money in these mud-holes? It was settled at Springfield last summer, and with wisdom, I think, that future probation is dubious. We need to behave, you see, so that we can be forgiven in this world for what we do, but I'm afraid some of our road-menders rely too much on the future. The church has a deep interest in Connecticut roads — much too deep between country churches!

Newspapers durstn't touch this broad-wheel question, because they are afraid of losing subscribers. Biciclers and triciclers don't know at all how their comfort and even their necks depend upon it. Politicians are mum because they are afraid of losing votes. But some one must declare that narrow-tired vehicles for road material, never have and never can be worth a cent, because they destroy roads ten times faster than they can build them. Long ago, I decided, from bitter, personal experience, that I wouldn't have a narrow-tired cart in a road job, for five dollars a day premium, let alone paying for having new work cut to pieces. No proprietor, now-a-days, who respects his land, will let a narrow-shod cart cross it after a load. Three shafts to a low-down cart is my latest idea for two horses. It makes the most compact team in existence.

See how the broad cart-wheel flattens every bit of road it touches! In new work the manager can see exactly what he is making. The wheels find every soft spot in time to mend it while it is fresh. Thirty to forty hundred on a cart, puts fifteen to twenty hundred on each wheel. The bearing of each six-inch tire, may be six by one and a half — two — or three inches, or more, according to the condition and quality of the material that is being rolled as hard as a rock. This pressure is a searching, twisting one, mind you — like the probe of a dentist for plugs of gold-leaf, always finding the softest places. The wider bearing of the steam roller cannot compete in this particular, as any dentist, caulker, or whoever putties a hole must admit.

For making good trotting at once, on loam, rotten sods, subsoil, or whatever, the wide cart-wheel has in the country no competitor. A few times running of loaded broad wheels over fresh work, would save all that laying down of posts and rails to force an unwilling public to drive on it. That fence-rail barbarism is an insult which marks the botch who has first injured us by making roads we are not glad to ride over.

A competent manager will easily find reasons for hauling a few loads lengthwise of his new work — towards its completion — to test the finish of it. Even in patching roads, he will think of this, in driving his empty cart. Then he will use a load or two of suitable stuff along the line to flush depressions, and smooth the slightly rough places that will appear, and which a very little earth will fill, and so puddles and holes will be prevented. Coal ashes can be laid in the mud solid as plank, under the tread of broad cart-wheels.

Once, when I was doing precisely this little patching of new work (so much neglected), an eminent town authority came along, who didn't see, or didn't choose to see what I was at, and asked me to explain. I told him I was "taking the shakes out of the road." That did not seem to enter his hair, so I took hold of his shoulder and gave him a decided tremble, saying, "We don't propose to have this road shake travelers like *that* when we have done with it!" The extra finish that I was giving cost fifteen or twenty cents probably, on twice as many rods of road. He cut my bill about ten dollars — whether for the shake I gave him or the thousands saved to other people, I never precisely understood. To do really good work we must make the work our most imperative master. The best manager or workman will know best how to spare labor and money when that is necessary, as it often is. To begrudge the few cents needful to secure a finish for what we have well undertaken, is the height of extravagance and waste. The work of bad road-menders is often worse than if it had never been done in the disgust it brings upon the public, and the decay it brings to the life of town and State in the matter of public spirit.

Here we have our last cartoon showing how our bad road-menders must treat themselves, or we must treat them in imagination, long before we can have any millennium; and also the way we constantly treat good road-menders now. It is an old, old story, fit to have in our hearts at Christmas time, and to regulate our conduct at all times, that the men who are true and honest workmen enough to save the world from its troubles, will not quarrel with the mob for the chance to do so. By their roads may we know them. Unless supported by their fellows the world is lost without them. It is the purpose of this paper and the duty of this Board of Agriculture to teach us to be watchful and recognize good road work, for of such is the Kingdom of Heaven.

These pictures are figurative, some of them, but they show how a woman, with no vote in the way her money is spent in this commonwealth, may help, with a graphic finger of approbation or scorn, to plan for better roads. It is safer, in general, to let a man learn his trade in front of his own door, where his wife can see to him. Because he does a good job there, every time, is no surety that he can repeat the pattern any where else. Still, good jobs in front of every man's door are what we need, and the public, though a fool, will not fail to perceive, that the gentle self-interest which every owner has in his own street-front should be cherished and educated, as the corner-stone of Connecticut road-making — not blighted by a lot of time-serving politicians, who propose to tax all but improve only certain streets, as their high mightiness may share the spoils with their party train-bands.

22
Reform Needed
Good Road Mender
Public Boot!
Now!
Bad Road Mender Before the millennium !!

The saddest part of my task comes in considering the growth and decay of public spirit — loyalty to duty and the higher law — such as we are so glad to have every one feel the force of more than ourselves.

But where should public spirit begin?

Our miserable failures, on every hand, date back to original sin — not so very far away, either. Man continues to be born an outrageous cannibal, who will consume his mother, eat the balance of his relatives, and conspire in corporations to devour the whole world, unless we lick ugly cubs into shape, and lead them to perceive — by hard knocks, if necessary — that their true role on this planet is to behave only a trifle worse than the angels.

Like public peace and confidence, a profitable orchard, or a happy farm, the roots of public spirit run deep, and so strong, in our case, that it once seemed as if they could never sicken and die. The seeds of patriotism to take effect now must have been sown in the hearts of peasants a long time ago. Richard Jeffreys says a beautiful woman dates back a hundred and fifty years, certainly. So does a good road-maker or farmer.

God don't make states — they are *grown*, by the blessing of goodness, out of the hearts, loves, happinesses, and necessities of mankind. He is no manufacturer! The fell dynamite and vials of wrath poured out upon us are crops of our own cultivation, or neglect, when men grow so wicked in wasting the fat of the land that the righteous have to buy kerosene by the barrel to make their faces shine.

Every one of those foolishly forcible enterprises, mentioned in the first place, turnpikes, canals, railways, telegraph lines, and thousands of other hurried conceptions, in which we reckoned without our host, the mother classes of society — the eternal common people — has helped turn the milk of human kindness to acid and destroy the very sources of public spirit in this commonwealth. They were continually injuring or ruining here and there a sparrow, whose heads were every one numbered and indelibly marked on the lives of the living. The poison of wrong-doing is cumulative, piling up like a mountain against us.

We skip the war, you see, but I'm shirking this branch of my subject, anyway, though it has everything to do with Connecticut roads. Besides the ill conditions we have grown, it would bankrupt the census appropriation to catalogue those we have imported, which die not, neither are they quenched.

Sequestering, by slow, imperceptible degrees, the powers of the General Court, in the hands of lesser courts and commissioners — legal trades'-unionists — who make their whack while the people are tormented with civil-war suits, is not working satisfactorily to either the people or their would-be masters.

Public spirit has come to such a pass in Connecticut that we are afraid an unpaid Legislature in session might behave like the old Boston tea-party.

The people carry burdens like camels, for a while, but the grade-crossings tax may furnish the very last straw — no matter where it comes from — which an outraged public will throw off. Grade-crossings are not all railway crossings, neither are railway crossings the most certain to kill people. Very often a common road crosses a polluted stream. Which shall be abolished? If some think this is an "old chestnut," I remind them, that the bell for it is a knell of death, tolling later and often, but usually unnoticed in this connection. It would be very liable to come into the halls of an unpaid legislature, convened to consider grade-crossings. We take a languid interest in raising the road on high bridges across those streams, because the more intelligent of us know that parallel roads are quite as dangerous and more tedious, especially when reeking zephyrs blow in our teeth. In this light Hartford will be seen to have lost in connection with its railway crossing. Can we raise public spirit on the banks of a polluted stream, is the question? The new statue at the Capitol shows how a continental patriot would start back in horror at sight of the fluid abomination.

The general decline of public spirit is well signified by a road paragraph from an inland New York town. We may judge the whole-world now, without leaving our own neighborhoods.

"The road question in our township is quieter than it has been for years before. We have a road machine and it does prime work. As managed here, one man bought the machine and does the road work for the township at a fair price. The roads are in better shape than they ever were before, and there is more general satisfaction all around. Far better than 'loafing out taxes on the road.'"

In this paragraph we get an unfair view of the last ashes of the old life, from which the new is expected to spring. The Connecticut town which rejected its most skillful workman with contumely, "for fatting cattle on the roads," at $2,500 yearly, is now spending $12,000 a year on its highways. Is this new departure entirely hopeful? We know something about road-scrapers, both the new and the old ones. Gouging into foot-paths and cutting down every man's entrance may let the public go its way fairly for awhile. But does this assumption of the people's business by contractors tend to the growth and nurture of public spirit along the highway? Especially when, after a few times using, the new scrapers, like the old ones, are seen to have nothing but gutter-wash to bite at, and travelers find themselves swamped in long lines of mud-marching.

Suffice it to say, that our machines, without the good will of the people, are worse than nothing — the devil's own inventions. *All the labor of a prayer-meeting can't be done by one man.*

In this, as in other matters, vital to Connecticut roads, I may indicate only by hints and glimpses of spot-knowledge what must be done next. It would be unbecoming for me to say more in a matter which equally concerns everyone and whereof anyone who chooses may speak.

The **Chairman.** There is now an opportunity to ask Mr. Olcott any questions which you desire answered.

**Mr. Meech.** I wish Mr. Olcott would tell the audience the size of the stone that Macadam found most valuable in constructing his road?

**Mr. Olcott.** I do not know that I can answer that question. They say that you must pass every stone through a three-inch ring.

**Mr. Meech.** My recollection is that the experiments of Macadam demonstrated that stone most valuable for road building should not be more than an inch and a half across.

**Mr. Cornish.** I would like to inquire of Mr. Olcott if there is any law which says that in making a town road the side of the road shall not be treated like the main road?

**Mr. Olcott.** I am not a lawyer, but I have always been told over east where I live that the road-master could cut into the sidewalk as much as he pleased.

**Mr. Cornish.** I would like to ask if road-makers have any right to injure their neighbors' walks before their houses or bar-ways by plowing a foot deep or more? There are some men who work roads who seem to take pleasure in destroying a man's bar-way or the walk in front of his house. I presume many gentlemen have seen the operations of these road-menders.

**Mr. West.** It is my opinion that the road-maker has a right to plow before any man's door or any man's bars, if it is necessary to protect the road and take the water off. We have a right as road-makers to turn water into any man's lot where it is necessary, except into his dooryard or into a lumber-yard. It is necessary to take the water off the road. In our hilly country we are losing all the materials for the repairing of roads from the fact that the water is not drained off. The address of the gentleman has been more particularly confined, of necessity, to the sandy regions of the State. If you go back among the hills of Tolland County or up into Litchfield County you will find stone enough and gravel enough without this intermixture, if we can keep the water off the road. The idea has been very general that we must have bars in the road. We must have them in certain places. I know places in our town where I could go with a hand shovel and in one hour turn the water which washes the road for forty rods by making a little bar and a little cut to turn the water down hill. There are places there where the road-makers turn it off to the side of the road and try to force it to run up hill.

We have not had anything said of the expense of building bridges. I am going to speak as though I was speaking to the Committee on Roads and Bridges in the Legislature. I see before me embryo legislators and I wish to call attention to the injustice of the present law in regard to bridges. Many people in this house are not aware that when that law was passed the town of Lebanon, from which our town of Columbia was taken, was the fourth town in wealth and population in the State. That law was passed a century ago, making it obligatory upon each town where a stream was the dividing line to build one-half of the bridges unless they could make a different agreement among themselves. Now, where do you find a board of selectmen, that, when called upon to build a bridge, has any soul or conscience as a board? We were called upon to build a bridge between our town and Windham, which is the direct route for the people of Columbia over to a part of Coventry and Hebron and the flourishing village of Willimantic. That bridge cost a little over $6,000, and it cost me, living seven miles away in the hill town of Columbia, fifty dollars to build that bridge, while gentlemen living within forty rods of the village of Willimantic, with the same assessment list, paid $2.50 for that bridge. You see the inequality. That law was passed when we were an agricultural community. Since then these manufacturing villages, Willimantic, Putnam, and all those places, have sprung up and prospered and changed the whole face of some portions of the State. It is for us as farmers, who wish to see equal rights and justice, to see to it that this law is changed, and that the towns shall pay in proportion to their assessment valuation, or else that the county or the State shall build all these larger bridges. (Applause.)

Mr. CORNISH. I would like to ask still another question as to the rights and duties of road-makers. Are they not obliged to leave a path between a man's fence and the road, of four feet or three feet, or can they plow to the fence ?

Secretary GOLD. The road-maker is a perfect autocrat, a despot. He has the right given him to use the whole of the legal highway. He may plow so near your fence posts or walls that they will fall down. If he has no conscience or sense of moral propriety to control him, he plows in front of your premises so that you cannot get out of or into your buildings safely, and may scrape up the dirt and pile it up so that it is dangerous for you to go out in the dark.

Mr. CORNISH. If you have a row of trees can he dig them up ?

Secretary GOLD. Trees in some cases are protected. You can get permission of the selectmen to set out trees in the highway, under certain conditions, and those trees are protected by special Act of the General Assembly.

Mr. WEST. If those trees are in the way of properly preparing that road, cannot the road-maker plow them up ?

Secretary GOLD. I suppose that he can, but if they have been planted there by permission of the selectmen it complicates the question, because they are specially protected by law. But otherwise his authority is paramount. He represents the rights of the public, and private rights must yield.

Mr. WEST. One word in regard to that. I will say without boasting, that for fifteen years I have kept the road in front of my buildings in repair. I say to the road-maker, "Stand off! The selectmen shall never have occasion to complain of this road; I will repair it." I have done so, as I say for fifteen years, and where it is necessary I have bridged every bar-way so that there is no obstruction to water running in the gutters by the side of the road.

Mr. CORNISH. Has a man a right to bring his fence into the road and keep it there?

Secretary GOLD. The law is that he cannot acquire any right to the land in that way, no matter how long he may occupy it.

Mr. AUGUR. I would like to ask Mr. Olcott or the Secretary in regard to under-drainage in wet places in the highways?

Mr. OLCOTT. That is a rather broad question and it is hard to tell here, what should be done in any particular case. I think an under-drain in the center of the road is a good thing to take the water out of a clay subsoil. But to say exactly where it should be done or how it should be done is difficult here. It is a matter for study on the spot in each case.

Mr. MAY of Woodstock. I would like to know if there is any remedy for the evil that arises from towns refusing to bear the expense of making proper roads? I know a town where the roads have been put under contract for a series of years, and a year ago the town passed a vote that they would take the roads out of the hands of contractors and give them over into the hands of the selectmen, and where they had been spending $5,000 a year under the contract system, they voted that the board of selectmen should have $2,500 to expend upon the 150 miles of road in that town, and that they should pay for help upon the roads, as they could hire it, only $1.50 a day. When the selectmen undertook to hire their help in the spring to go on the roads, the men said, "No, we cannot attend to it; our time is worth on our farms $2.00 a day or $2.50 a day. When we get through planting, and have nothing else to do, we will help you." Consequently the roads had to take the go-by. When fall came the people of that town, as the people of that class of towns generally do, called their selectmen to account. The expense had been kept within the $2,500 appropriation and they complained of the roads. I would like to know if there is any remedy for such a state of things. I think there is, back of all this, the fact that the towns are not disposed to be liberal in defraying the expense of good roads. Almost every town has men who know enough to make good roads if the town is willing to pay for them.

Mr. SEDGWICK. It seems to me there is no question in the State of Connecticut to-day that demands so much attention from the property owners as the state of the roads. I do not hesitate to say that of the money appropriated by the 160 odd towns in this State for roads, fully one-half is money thrown away, owing to the system by which the roads are worked. The old contract system which is in vogue in so many of our towns is a delusion and a snare. A man who takes a road to work under that system in nine cases out of ten takes it to make money out of the contract; in nine cases out of ten he knows nothing whatever about making a road, and in nine towns out of ten the contracts are made on the idea that it is a division of the spoils; and in whatever town the roads are let out in that way you will find that they are deteriorating year by year, and they have poorer roads to-day than they had 25 years ago. But in some towns in Litchfield County they have taken a step in advance in this matter. The money that has been appropriated for the repair of roads has been put in charge of the selectmen and they have been empowered to hire a competent road-maker and to give him the necessary tools, allowing him to hire a sufficient number of men to go on the roads the first day of May and work for six months steadily on the roads of the town. There are three towns adjoining mine in which this system is in vogue and the result has been, in every instance that I know of, that the roads have steadily improved in those towns.

Now, gentlemen, there is a reason for all that, and the reason is this: That where a road is let out by contract, the contractor is only interested in making that road good enough to pass an inspection, but where the money of the town is laid out under the eye of a man whose business it is to make roads, it is for his interest to see that every stone that is in the way of making a permanent improvement is removed, instead of merely throwing a little dirt over that stone, to be worn away by rains or to be worn away by the wheels going over it. The stones are removed, the ditches are opened wider, and the watercourses are opened so that the water can run off more freely, and in that way a permanent improvement is being made in the roads of the towns, which in the end saves money to the towns. I tell you, sir, that if we wish to make any progress in Connecticut in the repair of roads it can only be done upon the system of our towns hiring a competent man, putting him in full charge of the roads, and letting the repairs be made under him. I honestly believe that every town in this State that adopts that method can save 40 per cent. of the money that is now expended. There is no doubt about this, sir, and I say that until the property owners investigate this matter and adopt some thorough, systematic plan we shall have just such poor roads in this State as we have now and have had for the last 25 or 50 years.

Mr. ——— of East Hartford. A gentleman in the back part of the room asked a very pertinent question when he asked if there was any redress against a town if they failed to make their roads suitable for public travel. There is a means of redress in this matter. If the roads of any town are such that they are not suitable to be traveled over and become dangerous, any six citizens of the State can make application to the County Commissioners and they can be called out to take a view of the roads, and if they find them unsafe, they can order such repairs as are necessary to make them safe and suitable for the public convenience and travel.

Col. **Warner.** It will probably be a long time before our roads will be perfect. When that time arrives it will be very nearly time for the millennium to come. The towns in the

State of Connecticut have been for a great many years devising all sorts of ways to secure better roads, trying all sorts of experiments, and every town has passed through about the same experience. The lecturer to-day gave us a very good description of how to make a road provided we had plenty of money to do it with and the right kind of material; but in the rural towns we cannot afford to cart gravel a long distance on our highways; it costs too much money. We cannot afford to make a road the way the gentleman advises us to do it. In many of our towns we cannot get gravel. Now, how can we make our roads in those towns? Let me tell you what the town in which I have the pleasure of residing has done and what the condition of our roads is to-day. I will put the roads of that town in comparison with any roads in the State of Connecticut to-day, and yet we have not got a gravel bank to go to, and the taxes of that town are only eight mills on the dollar. Now, how do we do it? We place the matter entirely in the hands of the selectmen. Whom do we choose for selectmen? The very best material we can get in that town. (Applause.) We select the men who will do our work; men of integrity, who are not going to make a dollar out of these jobs. They are not selected by favor nor for friendship, but they are men who have a character to sustain, which is as sacred to them as the honor of any man. Those are the men whom we elect to the office of selectmen. We have to urge them oftentimes to take this position. The chairman of our selectmen is here to-day and hears what I say, and I am very glad to bear testimony to the admirable manner in which our roads are built and maintained.

Now, we have a road machine, which I consider to be a perfect godsend to the towns of this State. I do not know how we could have such roads as we have without a road machine, operated by powerful teams. We have to use the material by the sides of the road and as it washes out we have got to get it into the middle of the road, and that machine takes it and lands it there; it then goes over it and levels it down, and after the road is completed we throw out the stones. That is the way we make our roads, and we build them at one-quarter the expense we did before we had this road machine.

Mr. **Bartholomew**. I am so fortunate as to reside in the same town with Col. Warner and I simply wish to endorse what he has said as correct.

Mr. **Yeomans**. I presume that the old saying that "the roads of a country are an index to its civilization," was not intended to apply to the rural districts, if we are to believe what we have heard here to-day. With regard to this road question, I can very well understand that one great trouble in the way is a lack of proper knowledge of those great and essential principles that underlie road making and road repairing. Until those principles are understood and acted upon we shall not have good roads.

Now, as has been suggested, our friend who has read the paper, resides in a locality where all the conditions are very unlike what they are in other localities, so that the method which he has described may work very nicely in the soil which he has to deal with, which is supposed to be self-draining; that is, there is never any trouble arising from the freezing, lifting, and breaking up of the roads, such as will be found in some other sections. In my own town of Columbia, for instance, the soil is such that the stones would have to be buried so deeply that it would be an exceedingly expensive job, in order to remove them from any trouble that would arise from the frost.

A question has been asked with regard to drainage. That is an essential and a very important point in many localities. I can call to mind a great many roads that I have to travel over, which, if an under-drain could be placed in the road-bed so as to take off the water, you would find very much less trouble than exists as they are situated at present.

There is another very important point. If the travel could be distributed over every portion of the roads, they could be much more easily kept in repair. But is that so? By no means. Here is a regular track, the beaten track, or "tow-path," as we call it, where the horses pass, and on each side, at a regular distance, are the wheel ruts. Now, we have to work under conditions that are beyond our control, and those conditions affect very essentially the roads and the difficulties of repairing them. Now, you may take any road, unless it is a macadamized road, that is supposed to be firm, and take it in times of moist weather, and continual passing over that road will create a rut, and especially if this passing over is by heavy teams. After a time ruts are formed, water will work into them, and then the process of deepening that rut is very much hastened. In order to have our roads as they should be at all times would require constant labor. I can imagine a case where the selectmen of a town, as in the case spoken of by Col. Warner, who are looking out for the roads, who have a little pride in the matter, and desire to have the roads in as perfect condition as can be, are all the time providing for the little and necessary repairs that will save the road, to a great extent, from any serious wear.

A single word in regard to macadamized roads and I am done. A question was asked as to what sized stones were used. It is some time since I have read anything upon that matter, but my impression is that the true macadamized road commences at a considerable depth below the surface. There is an excavation made; the stones for the first course are quite large, and the size of the stones is gradually diminished until they come to the surface, and on the traveled part of the road they are quite small and tightly packed together.

Mr. Platt. The proper way is to have the work on our roads done by contract. There is no fault in the system, it is only the way in which the work is attended to. If the officers of a town are determined that the work shall be thoroughly done, I think there will be no fault found with the contract system.

Adjourned to 2 o'clock P.M.

## AFTERNOON SESSION.

The convention was called to order at two o'clock by Mr. J. M. Hubbard of Middletown, and the Question Box was again opened.

Secretary Gold. Does any one present know of anything to prevent the apple maggot from destroying apples? I am sorry to say that I do not think any one has discovered an effectual remedy for the apple maggot. A long discussion followed on the various insects affecting the apple and apple-trees, with remedies.

The Question Box was then closed to hear the report of Committee on Pollution of Streams.

Mr. F. M. Hawley of New Canaan presented the report on behalf of the committee, which, on motion of Prof. Brewer, was accepted and the committee continued for another year's service, afterwards amended so as to give power to fill vacancies.

After a solo by one of the members of the quartette, which was heartily applauded, the chairman said: The question which is to occupy our attention during this afternoon is one of the utmost importance, one in regard to which the interest is very general and very wide-spread. The railroad has come into modern life as a factor of tremendous importance, and we are as yet in doubt in regard to many points connected with it. We, as farmers, are specially interested in regard to many points connected with railroading, and it gives me very great pleasure to announce that we are to have this question discussed by a gentlemen who has given a great deal of attention to it, Prof. Arthur T. Hadley, of Yale College.

## THE RAILROAD AND THE FARMER.

By Prof. Arthur T. Hadley.

*Mr. Chairman, Ladies and Gentlemen:*

Your chairman has well said that this is a subject on which a great deal of doubt prevails — doubt as to what is going to be either the immediate or the final effect. It is one of those things of which the more you study it, the less, in some respects, you know about it. The best way, however, to find out what is likely to happen is first to look briefly at what has happened in the past, what has been the effect of railroading upon the financial results of farming in different parts of the country; to see if we can find the reason why it has had these effects ; and then to indicate briefly, as best we may, what are likely to be the effects of proposed methods of legislation and proposed changes of railroad economy in the immediate future.

The first effect of the introduction of railroads was to remove the advantage which was due to nearness to market. It did this not for farm products only, but for business of every kind. When goods had to be hauled by wagon, a large city must of necessity be supplied from the gardens, from the farms, and from the factories also, within a comparatively short distance of the city itself.

The invention of railroads changed all this; it caused goods to be produced, not of necessity near to the point of consumption, but wherever the natural advantages for the producer were best. It caused factories to be established near to the sources of supply, which sent goods all over the country, and finally all over the world. It caused farms to be placed where the land was most fertile, to raise grain and other products for shipment in bulk, so that the country produced food for Europe as well as for itself. Not merely was this the first effect of railroad invention, but it was an effect which was heightened by almost every change in railroad methods. It was at first supposed that railroads could carry goods, as they still carry passengers at the present day, at a fixed rate per mile, charging just as much per mile for 200 miles as for 100. It was soon seen that this was not good railroad economy. After you had once loaded your goods in cars, after you had been at the expense of building your stations, and the various clerks and other officers of the road had done their share of the work of that department, it made comparatively little difference whether you hauled those goods a hundred miles or a thousand; it was simply a question of a little more fuel to burn in the engine and a few more hours' work for the train hands. In other words, the terminal expenses became larger and the expense of moving the freight less. All the subsequent inventions tended to intensify this effect. Steel-rails, for instance, may not seem to have had any very obvious part in this question, yet their influence was enormous. With the use of steel rails you could load your cars heavier, you could run trains in greater number, you could move them with less expense for fuel, you could run heavier locomotives. All these things combined to make it possible for a railroad to do more work with the same track and the same equipment; they made it all the more an object for the railroads to secure large shipments in bulk; they made it less and less a source of expense to carry those shipments in large quantities for long distances. All this, of course, favored the West at the expense of the East; the development of the western country, with new railroads and new farms producing wheat and other grains for the export trade in large masses, gave the railroads a traffic which they could handle economically and with advantage, and they proceeded to devote their main attention to the development of that traffic. All this was right, but they went a great deal too far in the direction of developing the long-distance western traffic to the exclusion of the short-distance traffic. The western traffic was for the most part competitive; it had the choice of three or four routes to the seaboard. Any traffic starting from Chicago and destined for Liverpool can go from Chicago to Liverpool *via* Montreal by the Grand Trunk Railroad; it can go *via* Boston by the New York Central Road; it can go *via* New York by any one of three or four lines; it can go *via* Philadelphia by the Pennsylvania Railroad; or it may go by the Baltimore and Ohio Railroad and be shipped from the port of destination to the European markets. Now, the railroads struggled for this traffic with the most keen rivalry. It could be economically handled, it was furnished in large bulk, and it was something which, if one road did not take it, another would be ready to seize. You can readily see that under such circumstances they made a great deal more effort to secure that traffic than any other. A store, if it is subject to competition, will make much greater efforts for the accommodation of its patrons than if it has, for the time being, a monopoly. So it was found with railroads, that where there was competition they made special efforts; they thought that business, if gained at all, was so much gain; they were ready to carry it for anything above mere operating expenses, the mere expense of loading the freight into cars and carrying the cars full instead of empty; and the natural result was that not merely did they carry long-distance traffic at a lower rate per mile, which they had a perfect right to do, but they sometimes carried it for an amount absolutely less in the aggregate than the shorter-distance traffic. They charged less from Chicago, from St. Louis, and from other competitive points, than they did from the intermediate points. It was felt by the shippers at intermediate points that this was unjust, that it was an unreasonable discrimination; not merely that it built up the business of those points unfairly, but it made the local shippers unable to compete in the market with those who had these special advantages.

The result was an effort to stop this by legislation. The first attempts of this kind were crude, as is the case with all first attempts in legislation. People never know what they can do and what they cannot do until they have tried, and they usually contrive to make a good many mistakes before they find out. It was so in this case. The first laws that were passed to regulate railroad charges attempted to reduce them to an equal mileage basis; to take the lowest charge that any railroad made and say, "This railroad shall not charge more than this amount per mile." Such was the nature of the legislation of many of the Western States in '72 and '73. The legislators saw that the railroads were taking grain from Omaha, or from Minneapolis, to Chicago, at a rate of, let us say, twenty cents a bushel, and they argued that if the rail roads could make money by carrying freight the whole distance at that rate (rates were very much higher then everywhere than they are now, because railroad economy was very much less developed), they could make money by carrying it half the distance at half that rate. Of course that was not so. The expense of loading and unloading, the expense of station service and the administration of the road, remained the same; only a small part of the expense was halved by halving the distance to be carried The result was disastrous, not merely to the railroads, but to the very men who had passed these laws. It was found that those railroads could no longer pay the interest on their bonds; that they could no longer get money for making the necessary repairs; that the development of railroad facilities ceased; and the men who were most desirous of passing the laws in order that railroad charges might be reduced found that they had really done themselves more harm than good. If they were not willing to let the railroads make rates on a system which would enable them to pay for facilities, they could not have the facilities at all. When rates were reduced to a point where the railroads could not pay any interest on the investment, the community suffered from the fact that no more railroads were built, and so the laws were repealed.

But they had learned something. They had learned a very important lesson as to what they could not do in the matter of railroad regulations. The next attempts did not go so far. In subsequent legislation they entrusted the enforcement of those laws to the discretion of commissions, who were to point out where the abuses were most serious ; men who had studied railroad business sufficiently to know what laws could be passed that would strike the really unjust discriminations and could be carried out, and distinguish such laws from those which would strike at the principles of good railroad economy, and which would therefore be undesirable for every one.

I have not time to go over in detail the history of railroad legislation. Suffice it to say, that as one State after another passed its laws, people learned to distinguish between those which could be enforced and those which could not; and that finally they succeeded in obtaining the adhesion of a majority of the members of Congress to a measure of interstate regulation which. while imperfect in some particulars, is nevertheless a most decided advance over anything which we have hitherto had. What is more, it is not merely a tolerably good law in itself, but it is administered by a commission which, so far, has shown evidence of great wisdom, and succeeded in avoiding the most serious difficulties of the subject.

This law prescribes, in the first place, that no railroad company shall make secret rebates or drawbacks in favor of one shipper as against another who ships goods of a similar kind. This is unquestionably right. All persons ought to have the same chance for shipment of the same class of goods on a railroad, with only a fair allowance for the difference in economy accordingly as they ship parcels or car-loads.

In the second place, the law says that no railroad company shall, under similar circumstances and conditions, charge more for a part of a distance than they do for the whole ; that they shall not charge more to or from an intermediate point than they do for the whole route ; for instance, not more from Bridgeport to New York than from New Haven to New York ; not more from New Haven to New York than from Boston to New York. The law does not attempt to force upon railroads the principle of equal mileage rates ; it does not say to the railroads, "you must reduce your charges for the shorter distance in proportion to your charges for the longer distance," but it says, "you must not create arbitrary inequalities in favor of the long-distance traffic." Some exceptions are allowed to this rule. The law gives the commission discretionary power to allow exceptions in certain cases. For instance, where our railroads are subject to the competition of foreign roads which cannot be controlled, it is plain that the effect of this equalization would be to send a large part of the long-distance traffic by the Grand Trunk Railroad, which is not subject to the same restrictions as our own railroads. Also, exceptions are made in the case of water competition. But these exceptions are comparatively infrequent. As a general rule, it is the law of the land that the nearer points shall not be charged more for the same class of goods than the more remote points. This is sound economy from the point of view of the public, and, in general, also, from the point of view of the railroads. It will do away, in large measure, with some of the worst abuses which have prevailed in giving long-distance shipments an advantage over those for a shorter distance. It will restrict within very narrow limits those practices of which I have spoken, by which the farmers nearer to the markets were put at a disadvantage.

But meantime another series of forces has been at work upon railroad economy more powerful than any Act of Congress. The fall in the price of wheat has had more to do with the question of what railroads can do with their long-distance traffic than any law which could be passed by any State or by Congress. As long as wheat in Liverpool sold at enormously high prices; as long as wheat in Chicago sold at $1.15 and $1.20 a bushel, it was possible for the Western farmers, the railroads and the ocean steamships, all to make money out of the business. But as more railroads were built and more farmers went into wheat raising, the supply of wheat in the Liverpool market drove down the price, and there was less margin above the cost of production for the farmers, the railroads, and the steamships, to make any money. And this was not all. This development of long-distance traffic was something upon which other countries besides America could make experiments. Russia began to build railroads, not merely for handling wheat but for handling troops. After a railroad had been built for handling troops it was not of much consequence whether it paid interest on the cost of construction or not. The rates were simply made to pay operating expenses, thus lowering the price at which the Russian producer could lay down his wheat in Central Europe Thus, by the construction of Russian railroads and the development of the country, the sources of supply of wheat for the markets of Central Europe were vastly increased. This drove down the price of wheat in the English, French, and German markets; and inasmuch as the profits to the producer, to the railroads and to the steamships, had to be paid finally by the consumer in the European market, the lower that price was driven the less money there was in the business, until finally it gave no profit at all.

Western wheat will by no means contribute the large profits which could be secured a few years ago. In 1881, with wheat at $1.15 cents a bushel in the Western markets, the railroads could afford to make every exertion to develop this traffic. With wheat at 70 cents a bushel the case is wholly different. And this, gentlemen, is a more potent cause, I think, than any change in national legislation, which may lead to a difference in railroad economy and railroad policy. If wheat rates are down at every point, if there is so little money in it for the farmers that there is no chance of getting any more for the railroads, the inducement to concentrate attention on the long-distance traffic is very greatly lessened. If they are losing half a cent a bushel on every shipment of wheat that they carry, no amount of development of that traffic on those terms is going to make a railroad very rich. If they are going to make any money, the railroads must look somewhere else; they must look in the immediate future more to the development of local traffic; in other words, to that which more directly interests the people of Connecticut. (Applause.)

The question now is, how can they do that? In what direction is any such development likely to be looked for? There is unquestionably money in local traffic if we only knew how to develop it.

There are, I think, two ways in which we may look with considerable confidence to an increase of railroad facilities and a lowering of railroad rates. In the first place, the suburban service of our city railroads is as yet in its infancy. The suburban service only extends a short distance; the trains run for the most part over elevated railroads or something of that sort; for points 15 or 20 miles distant from the cities, the train service is as yet by no means what it might be. If our railroads can adopt such a system of passenger rates and passenger facilities that some of the people who now crowd into our cities will find it for their advantage to live in the country, they will do good to the community in every direction. In the first place, they will lessen the tendency to crowd vast masses of humanity into the tenement houses of our large cities, which is in every respect one of the most serious social dangers which we have to face. If people can live in the country, they will save more and produce more; they will bring to the railroads not merely their own passenger traffic, but the traffic resulting from their own shipment of parcels to and from the city. There will be a direct gain; but the indirect gain, and the direct one to the community at large, in such distribution to smaller villages and throughout the country, will be a much greater advantage. Efforts to secure this result have been made in Europe, and have been made with, on the whole, extremely good success. They have attempted to put local passenger rates at a figure which would hardly cover expenses, trusting to the fact that such low local rates, by inducing people to move into the country, would more than pay by the indirect gain to the road in the way of parcels traffic, and on the whole they have succeeded beyond their expectations. Not merely have they made low local rates, but they have made their periods of commutation short. Our railroad commutation rates are made almost exclusively for quarterly periods, and that prevents those people who most need the reduction from taking advantage of it. The man who has an engagement to work in a factory out of which he may be thrown at a moment's notice does not want to spend ten, fifteen or twenty dollars for a quarterly ticket, when, during the last part of it, his work may have failed him entirely. In Europe they not only make excessively low rates of a fraction of a cent a mile, but commutation tickets are sold for one month, and, in some cases, even for one week. The possibilities in this direction are, I think, very great.

But what the railroads can do in this respect they can also do in respect to freight traffic. Our railroad managers have not, as a rule, done what they could to stimulate enterprise in the matter of local freight. It is inconvenient to the railroad officials, being in some respects costly to handle as compared with through business, but they can also get very much higher rates for it than they can get for through business at present. The parcels can and will pay more than through freight that is shipped by the car. This seems to be the only direction in which there is very obviously room for the development of high-grade freight at present. Look at the amount of farm products that every year go to waste because they are perishable and there is no chance of getting them to market under existing rates, and then look at the price that consumers in the cities have to pay for those apples that lie rotting on the ground in a good apple year! The difference between the price which the consumer has to pay and the price at which the producer has to part with his goods if he sells them at all, represents an amount out of which payment for the transportation service can be made and leave something for the benefit of the producer at one end, and some benefit by way of reduction in price to the consumer at the other end. I do not say that it is easy to see how these details could be carried out. It is a difficult thing for any man to work out in his own head the question how these things could be carried out. He had better at once appeal to the various railroad presidents. It would be good economy for the stockholders to employ a railroad president at a salary of $20,000 a year to solve this problem, and it would be good economy for the public too. It is not a thing which any man has the wit to solve all at once. These plans by which Western wheat has been so cheaply moved were not developed out of any man's head or out of any dozen men's heads, but the necessity for the traffic grew and the means were devised.

There is at present, and, so far as I can see, there is in the immediate future, no more large profit to be made out of some of the bulky shipments of through freight on which the railroads have in time past laid chief stress. There is, at any rate, the possibility of profit in the development of local traffic; and I trust that our railroad managers are shrewd enough to see this, and that they will gradually turn their attention in that direction. I trust, also, that they will have the coöperation of the community in pointing out where the chance is. For they did not develop the wheat traffic, they did not develop the meat traffic, they did not develop the cotton traffic, without having the coöperation of the producers. A railroad man is not omniscient; he knows a great deal about his business, but other people know more about their business, and it is only by interchanging ideas with them that he can determine where the chance of developing trade is best to be found.

It is to these means, I think, that we must look for better railroad facilities, rather than by attempting to prescribe what railroads shall charge. If you prescribe what rates railroads shall charge, and say they shall not make certain rates in favor of certain individuals, you cut off traffic, and are in danger of cutting off your own facilities. If, on the other hand, you show the managers of a railroad how they can help you by developing your traffic, there is a chance for us to see better means of getting our products to market, as well as better prices for our products in the immediate future.

This is an audience which has no sympathy with the foreign method of trying to raise wages or to increase profits by cutting off the profits of somebody else. The American method of increasing our profits is by developing our own business. What we are asking is, that other men shall give us a fair chance to develop our business, and then we trust that we and they together can work to sufficient advantage to find a way in which we can make a living. (Applause.) This development, gentlemen, is the thing to which I am looking forward with hope in the immediate future. It is, as I said, not a thing which is going to work itself out. Anything which is really worth while does not work itself out without a good deal of hard pushing and hard thinking on the part of those most interested ; but I think that we may see a chance in that direction and may work for it.

The CHAIRMAN. Before proceeding to any discussion upon the exceedingly able and instructive address to which we have listened the audience are invited to listen to a duet by our choir.

After the singing the chairman announced that the subject upon which Prof. Hadley had spoken was open for discussion.

Mr. J. L. COWLES of Farmington. Some three or four years ago it was my privilege to spend some little time in the old city of Brussels, in Belgium. While there I was located near the railroad station, and it was my pleasure to notice every morning the arrival of what are called there the workingmen's trains, which came in every day bringing the laboring class from their little homes to work in the city. Those trains are arranged to start early in the morning so as to arrive in the large cities in time for the men and women to commence work at the factories. The rates on those trains are very low. I think that for a distance as far as from here to New Haven the charge is not over sixty cents a week, to and from. Now that is a wonderful benefit to those people. As my friend Mr. Hadley has suggested, it enables the men who find work in those factories to live in the country, where they can have little gardens, where they can have abundant space to live in, where their children can grow up strong, healthy men and women. Now, it has seemed to me that this would be one of the greatest blessings that could possibly accrue to our State. If such trains could be run upon our railroads at those very low rates, it would enable our workingmen, when they cannot obtain occupation in their immediate neighborhood, to come to the city. It not unfrequently happens that in some of our smaller manufacturing towns work is difficult to find and men are forced into idleness, and, being forced into idleness, the most natural thing for them to do, in many cases, is to go into the liquor saloons and there to spend such wages as they have earned. Now, if we could have such trains as I have suggested, say from Hartford to New Haven, which should reach New Haven at or before seven o'clock in the morning, going back in the evening, all the men along the line of that road would not only have an opportunity to find occupation in the little towns in which they live, but they would also have an opportunity to get work in the cities. That thing is done in Belgium, and I am told that that system has been found profitable to the railroads of that country. It seems to me that in this line our railroads might find means not only of profit to themselves but of immense benefit to our working class, and everything that is done for the workingman, who has nothing but his hands and brains to depend upon, is done for all classes in the community. Therefore, I think that in that line our railroads may adopt a method which will be of infinite benefit, not only to the railroads themselves but to our working classes, to our farmers, and to each and every citizen.

Now, I believe that New England is once more to take her place in the front rank as she has done in the past. We have passed through an era in which I have often heard it said that New England had seen her best days. I do not believe it. I think that this reduction of the charges for carrying our working classes which I have suggested, and the reduction in freight which my friend Mr. Hadley has suggested, will be of wonderful benefit to us. I think that the railroads may make reductions in the line which he has suggested that will be of benefit to themselves as well as to us.

Mr. **Randall.** The gentleman seems to lay great stress upon the point that the railroads should be educated to reduce rates in behalf of the working classes. It seems to me that we are all rather prejudiced against railroads; I know I am; but very often we do the railroads an injustice. Men who have invested their capital in railroads are very quick to see any benefit that they may derive by reducing rates. Any one who looks over the commutation rates of our railroads will find that those rates are extremely low for all classes of people, if they buy those commutation tickets by the month or by the year. Railroads are always quick to reduce their rates to a regular passenger who is riding every day in the year. I had occasion some two years ago, living eighty-three miles out of New York, to get a commutation ticket that only cost me forty-three cents a day. What lower rate, gentlemen, do you want? I could ride 166 miles every day in the year, if I chose, for forty-three cents. What we want to do is not to educate the railroads,— the railroads are educated — but to educate the people in the cities to bring their families out of the cities into the country. (Applause.) The men who are living in tenement houses in New York city, with twenty or thirty families in a house, pay more rent for two or three rooms than they could hire a whole house for twenty miles away on Long Island, in New Jersey, or in West Chester

County. Any man who has visited one of those tenement houses will agree with me, I think, that the thing to be done is to educate those people, and the railroads will do their part afterwards.

Mr. ———. Will the gentleman who has spoken of the workingmen's train in Belgium give us some idea of the accommodations furnished at that rate? Would those people in New Haven like to ride in an open box-car without any seats?

Mr. Cowles. If I am in need of work, and by riding in a baggage-car I can get to my destination for ten cents, which I have got in my hand, when to ride in a palace-car will cost me fifty cents, which I have not got, I shall be very glad to go in the baggage-car. I want to say further, that I have ridden with a number of gentlemen to a convention of this character for a considerable distance in a baggage-car, and I was exceedingly comfortable. I think that the great thing is to enable our people to get to their work, and it makes but little difference, if a man is going a comparatively short distance, if the cars are not very comfortable; the great point is to be able to get there. As things go on our railroads will improve their cars, but the main thing is to get to the place where, when you get there, you can do something. If we want to get people from Hartford to New Haven, and the railroad cannot afford to give us anything but baggage-cars, I think it will be a great deal better to have those baggage-cars, provided they will take men to and fro for fifty cents a week, than not to have anything to take them there. I think the one thing above all others to which the prosperity of this country is due is the fact that the railroads have enabled men to get rid of products which otherwise would have rotted in the field or rusted in the workshop, and enabled men to get work who would otherwise not have been able to get it.

Mr. Olcott. I listened to Professor Hadley's address with the highest intellectual pleasure, perhaps, of which I am capable, but in relation to my own hobby here to-day, I want to ask him if when he spoke of the development of local railway traffic he might not also have said something about the improvement of our common roads. It may seem at first glance as if the poorer the common roads the better for the railway. The reverse of this is really true, and I believe we may reasonably hope that our enlightened railway men will soon see that better wagon roads are needed for the prosperity of local railway traffic (applause).

Professor HADLEY. I take pleasure in saying that I fully concur with the expression of opinion just given by Mr. Olcott, that one of the most important things for railroads, in order that they may have a business that they can do economically and well, is that the wagon roads should be so arranged that the goods can be brought to them at low cost.

In regard to the question of railroads in Belgium, my impression is that the statement of Mr. Cowles is correct except in this: I do not think that sixty cents a week applies to so great a distance as from New Haven to Hartford. My impression is that those trains do not run over fifteen or twenty miles. They are short-distance trains. In order to carry passengers at such very low rates, however, it is a matter of necessity for the railroads, if the business is to be made at all profitable, to give comparatively rude accommodations. No railroad can afford to have cars run at that rate unless it can use those cars for other traffic all through the day. The regular passenger cars are kept for the regular passenger traffic, and they have to use cars in which they can carry parcel freight in order to make those extremely low rates. It is, of course, an element in good railroad economy that any train used for that purpose should be capable of being used all through the day. I must say that people who have to stand up in the cars of the elevated railroad would not be very much worse off if they stood up in box cars, provided a few springs were put on the bottom of those box cars.

Mr. WEBB. This is an entirely new idea to me, but I think that any means by which people occupied in the cities could be enabled to establish themselves in the country, and go cheaply to the cities to their labors would be of very great advantage to them. It has occurred to me that the reverse of that would also be a very great advantage to us and to all New England. We, in the country, oftentimes require a considerable amount of labor which we cannot procure for the reason that the people in the cities cannot come into the country and help us. Now, that thing might work both ways and be of immense advantage. It frequently happens that the farmers in the vicinity of these large manufacturing towns require in summer and at the time of harvesting a large amount of extra labor beyond that which they feel justified in employing during the other six or eight months of the year, and how often it happens, if you go into a city, that you find a large number of idle people there who are perfectly willing to work, anxious for work, but who live a little too far off for them to walk. It is a matter of very great importance, in my view, that these facilities should be furnished, and that the farmers should unite with the railroads in the discussion of this subject, and that some plan should be adopted to enable poor people, who are anxious to labor, to go into the country and procure it. There is not a farmer here who is not grumbling a great deal of the time — "I cannot get men to harvest my crops."

Mr. SAUNDERS. I would like to ask the gentlemen how carrying working people out into the country is going to benefit the farmers financially? I admire the public spirit which they manifest in saying that they would like to get them out there, but I must say that it seems to me that the city is the place where the farmer markets his crops, because people live there, and if the working class move into the country and buy or hire an acre of land with a small house on it they would very soon become farmers themselves, and in a short time the markets which farmers are seeking for in cities would be gone. If I am wrong I would like to be righted.

Mr. WEBB. I hope there is no farmer who wants to exercise a monopoly. I want to see farmers produce all they can so that there will be no starvation, and the matter of labor will regulate itself in time.

Mr. **Cornish.** I would like to make one remark from my own experience. I have had occasion to get men to help me, and I could find the men, but I could not find a boarding-place for them. I went to four different places to get a good, reliable, responsible man boarded, and nobody could board him; they were all full. Country farm houses are supposed to be large enough to hold a good many, but I did not succeed in finding a place until I went half a mile from home, where I finally succeeded in finding a boarding-place for him. I know in the summer a good many men came down and wanted work around the lower part of East Hartford, and they could not stay in places where they were wanted, because there was no boarding-place for them, whereas, if they could have been carried up and down by the railroad at a cheap rate they would have been glad of a job, and we would have been glad to have them. It would have been a great advantage to the farmers in that district.

Mr. **Marsh.** I can sum up what I have to say in a word or two. We have miserable help enough already without taking any more from the cities (laughter and applause).

Mr. **Kirkham.** Do you find any trouble in keeping men in the city from walking out to your farms and walking back to the city?

Mr. **Webb.** I see a good many young men walking out and walking back on Sunday, and I know there are a good many men living in the city who would be very glad to come out and help me if it were not so far. They can come if the railroad will provide for them. They could come on two roads within half a mile of my house, and be on hand so as to go to work at seven o'clock in the morning.

Mr. **Peck.** I think a good many problems could be solved if we could determine in our own minds what we can do without, and while we criticise the high charges of railroads I believe in giving credit where it is due. This gentleman from Long Island, as I understand it, rode 166 miles a day for forty-three cents; no doubt he could ride twenty miles for a merely nominal sum, and the accommodations furnished by the railroad would be immensely superior to those of the road in Belgium.

Mr. **Randall.** The gentleman has spoken of my riding 166 miles for forty-three cents a day. I will say, for the information of that gentleman, that the price of commutation tickets on that road for a distance of from ten to fifteen miles is from three and a half to four dollars a month. We do not ride in box cars, either, but in first-class cars, as good as any on the New York & New Haven road. The same thing is true of all the roads in that section.

Mr. **Platt.** It has been said that people who live in small villages should be educated to build houses to live in. In most small places the men from the cities could not find dwelling places to go into. Therefore the farmers and citizens of the villages should be educated up to the point of building small dwellings, and then invite the artisans and workingmen to come out and fill them.

This closed the discussion on the subject of railroads, and after a song by the quartette the chairman introduced Miss Sara J. Smith, who read the following paper:

## OUR HOMELESS CHILDREN.

### Miss Sara J. Smith.

*Gentlemen, Members of the Board of Agriculture, and Farmers of Connecticut:*

We ask your sympathy and interest in behalf of the homeless children of our State.

Not for the children of some far-off foreign land, but for the boys and girls who to-day, perhaps, are playing around our own farm-house doors, and sheltered by our own farm homes.

We all know that from homes of vice and poverty, and also from homes of wealth and vice, come hundreds of children whose souls have been attuned to vile words, coarse manners, and wicked deeds ; bold bad children, sent out from their homes because they could not be restrained there, or because death had taken their parents and they are left homeless and friendless.

Thus they become wards of the State, and it gathers these corrupt children into its great reformatories, to protect, reform, and christianize them. It gives them what their parents never gave them, restraint; endeavors to make them what their parents never made them, industrious.

This is a duty of the State, for self-protection if for no other reason; but there is another, greater reason. Christ has taught us "to love our neighbor as ourselves," and "to do unto others as we would be done by."

Do we, in arranging these great charities, carry out these "golden rules" in doing our duty?

We have the Kindergarten to take the little ones out of the streets before they are ruined. We have the orphan asylums in the cities, and the temporary homes in various towns, to put them in until homes in private families are found where they can be placed to be taught, and brought up as servants, or adopted as children of the family.

We have the reformatories, the poor-houses, and——we may call it a charity too, the prisons.

Link after link all these are in the great chain of charity. Yet some links are still missing in our chain. We ask you now to help forge one of them.

We ask it in the name of our homeless, friendless children, in the name of those not needing reformation, but protection, and instruction how to earn their daily bread. In the name of children too old to remain in the temporary homes, or the orphan asylum. Capable, industrious children, who would be anxious to support themselves, and perhaps showing aptitude for special work or trades. We ask for these children a real home of industry, or manual training school, a home by themselves away from contact with evil.

The State charity that deals with our children is, and perhaps should be, a cold, systematic charity, it must have caution for its watchword rather than sentiment in handling public funds. But it is almost a shade colder, and more critical than the great world itself.

A charity that takes all, the good and bad, into the same fold; and though it clothes comfortably, and feeds well the body, it ties down the spirit like a chained wheel, and the soul alone is left free, to imbibe sin if it will, sin that so soon mires and mars all purity that it seems never to have existed.

Are there not hundreds of children in these folds who came out from orderly, comfortable, even luxurious Christian homes ? Came out motherless, fatherless, friendless, homeless, tender, innocent ? Came out to go where ?

Who is there to open hearts and arms to the bitter cry of these children ?

Only the State. Again and again it gathers these little ones into its arms, and casting them into the same fold with its wolves, it bids them, these innocent children, to work and be happy, to listen, and see, and learn, and yet be lamb like and sinless, to walk into pitch and not be defiled.

Why have we not long ago had a home for such, that so many need not be contaminated, that so many need not have been lost. How can we pray each day, " lead us not into temptation," and then heedlessly expose weak children to the grossest temptation ?

What else is it when we so mix together the children ? What can we call it but temptation ?

What are our reformatories for ? Where else do we place the children picked out of the streets, found thieving and drinking ; where the dissolute, disobedient children, soiled in mind and body, no purity left ? To what place do we consign whole families of neglected children that wicked, drunken fathers and mothers will thrust upon the State that will support them, and not tax the drunken father and mother for it, but leaves them free to spend their time and money in drunkenness, while it taxes *us* to support those children, to say nothing of the taxes we pay for those parents, until the final tax to bury them.

It certainly is for those children that reformatories are built; it is for bad children we so willingly lavish money and time and thought, and use every available means to reform and make them happy in goodness and purity.

But ——— where do we place the guiltless little children that come to our care ?

I saw last week a little child who was sentenced — hear that word "*sentenced*," that is the legal term — in November, 1887, until 1895, to live, learn, work, eat side by side with bad children. And for what was she sentenced ? A little girl, guiltless of crime, not even a willful child, but guilty of being without a home and friends ! Sentenced for being without a home and friends !

Now do you think she is the only child of that stamp thus sentenced there? No, by many, no! But were she the only one it is a sin on our part even then; how much more a sin when there are many.

You may say they have care and oversight. They do have good, kind care, motherly care; but can a mother with fifty, or a few less, children to look after every hour of the day, and the night, can she keep separate the lambs from the wolves?

Can we picture to ourselves the possibility that ere a month goes by one of the young daughters of our homes might be bound for years in the reformatory at Middletown, or that one of the noble boys we so proudly plan for might form one of the rank and file of the school at Meriden?

Yet why not? Is any one's home or wealth so secure; are any friends so true, that if death comes to-morrow, to-night, that any one can be sure that there still will be home, wealth, and friends for the dear little ones left?

There are others' sons and daughters, from just such homes and friends as ours, who were sent there. Untangled in sin, unused to coarseness, shuddering for months at the contact they could not prevent of those around them, and from whom even kind officials could not protect them.

Young girls, whose mother had shielded them from all ill, and who in dying went out of this life with a piteous cry to God, and in mortal agony, because she knew there was no one left to care for her children as she had done; because she knew stern, cold men would take them, and place them where there would be no redress for all they must endure.

And why must they be placed there?

Because there has been, until we had our temporary homes, no other home to take them, and shelter, and food, and clothes they must have, and at Middletown and Meriden they can have all that in plenty, and instruction besides, for in these institutions they must commence at once to learn to be self-supporting.

And for this class to learn to be self-supporting they must have industrial training. They do have it in our reformatories, and though for the girls it is in advance of the training for boys, yet for both it is an undeveloped system, and we have yet to learn from States in advance of us how a good system may be developed.

Much might be said upon this subject; I touch it lightly, for as time goes on we will hear it discussed through the length and breadth of the land, and we all have much to do and to think of before this greatly-disputed question of industrial training for the masses can be settled.

Meanwhile we have here a chance to forge this missing link in our chain of charities. Hartford has had a gift, and the State, through this her capital city, has a right in this gift of a farm of 208 acres, whereon to found a home and school.

Those who are to hold it in trust, hold it for the boys and girls for whom we hope to rouse your warmest sympathy and interest.

We ask your earnest coöperation in developing on "Prosser farm"—which lies on the hills to the northwest of this city—homes, where homeless, friendless children may be taught that which will keep them good, and make them capable.

Where they may be surrounded by the same home influences that we surround our children with in our own homes.

A school for protection and industry, a school for developing the good, and not for reforming the bad.

A school of active, healthy, willing industry.

The CHAIRMAN. Mrs. Virginia T. Smith, a lady who is well known by name, at least, to you all, and I presume by voice to a great many, has kindly consented to talk to you, as she says, in continuation of the subject of the address to which you have just listened. I have the pleasure of introducing Mrs. Smith.

## ADDRESS OF MRS. VIRGINIA T. SMITH.

I do not know that I ever stood before a company of farmers until now, and yet I never felt so much at home in my life. I think it is one of the most fortunate things which can happen to any child to be born in the country upon a farm. In just such surroundings I came into life, and I want to reiterate what Miss Smith has just placed before you. I will be just as brief as possible, and touch upon a few things which I think are important in bringing this grand and beneficent gift of Mr. Prosser to your notice.

About two years ago Mr. Prosser came into my office. I did not remember having seen him since I was a little girl, but we were born in the same town, just north of us, in Bloomfield. He said to me, "I am greatly interested in the work for children. I have read with a great deal of interest your reports from year to year, and I have made up my mind that I would like to give my own place in Bloomfield, where I was born, to some charity for the benefit of children. Can you tell me what can be done?" We talked the matter over with great interest, you may be sure. It is a farm that is situated most delightfully, about seven miles northwest of Hartford, and lying to the southwest and the southeast, so that the portions of it which would be cultivated are admirably situated. The cold winds do not strike them as they would on the other side of the mountain. There are five springs on the place, which give it its name — "Cold Spring Farm." It contains 208 acres, a little more than one-half, perhaps, not quite two thirds of it lying west of the main road, and the remainder east of the main road. It has been thought, both by Mr. Prosser and other friends of the enterprise, that it is a very desirable place for both boys and girls. The farm is so large that it could be divided, and separate and distinct houses provided for the training of both sexes.

Now, in speaking of industrial schools and reform schools, I do not wish to be understood as underrating them in the least; they are doing a very important work for children throughout the State; but I do believe we should not begin to reform children before we have given them a chance to become good children, to prevent them from needing reform. We have an imbecile school at Lakeville, which takes our feeble-minded children, and it is wonderful to see what they do for them there. We have temporary homes, with which you are all probably familiar, as we have one now in each county. I hope they will never be anything else than families of children. The most successful temporary home will be empty when there is no child in the county that needs to go there.

Now, in addition to the imbecile school and the temporary homes, we have orphan asylums, and we have great correctional schools. I think the last time I visited the industrial school for girls at Lancaster, Mass, where they have fourteen counties, while we have only eight, I found sixty inmates. I believe in our industrial school there are to-day more than two hundred, although we have six counties less, and of course a great many less children than they have in Massachusetts. The reason is, there is no other place to send them. I was at Meriden a short time ago, and saw two little boys in the Reform School. I inquired why they were sent there, and was told that they had come to Meriden, their father and mother died, they could not be put into the poor-house, and there did not seem to be any other place for them. They were both bright, capable boys, and the older one, I was told, had a strong desire to be a farmer. He ought to have been put on a farm three or four years ago. Now, friends, those are just the children to whom we want to give a chance for manual training and farm work at the Prosser farm. We have in the Meriden reform school, I think, between three and four hundred boys, and it seems to me it would be far better to put them in family houses than to congregate them in one large institution. I was at the capitol last winter when an appropriation was made for the erection of a reform school building at Meriden for the children. It seems to me that if a small portion of that money could have been expended on the Prosser farm, where boys who are not really incorrigible might have the privilege of going and learning the rudiments of a trade and the practical work of a farm; it would have been a great blessing to the children, who might eventually have an opportunity to go into some kind and charitable homes.

There are a great many children, during the year, that fall into the hands of the officials of the State charities, and of the local charities in the cities, and the great question is what to do with them. I want to say a word on that question. Don't let us send them to the reform schools; they do not need to go there. There is a plan that perhaps some of you have heard of in New York State, which is progressing slowly, and our plan with respect to the Prosser farm is to be something like that. It is called "The Burnham Industrial Farm." Mr. Frederick G. Burnham of New York gave five hundred acres in the town of Lebanon for the same purpose, — that is, of taking charge of boys. They are committed to that farm school and looked after in the most careful and unremitting way, to be sure that their discipline is all right, and that their education is all right, and still not permit those children to feel that they have been guilty of anything, or that the fact that they have been there leaves any stain upon their characters. The president of the State Board of Charities of New York goes so far as to say that any thinking person who sends a child to the reform school, when he ought not to go there, is guilty of a crime. He thinks that the future of a great many boys has been blighted by sending them to correctional schools when they did not deserve to go there. It seems to us that the Prosser farm school, the temporary homes, or the orphan asylums are the places to which such children should be sent, and that only those who are incorrigible, who need to be restrained, and need to have pretty severe discipline at times, should be sent to the reformatories. We say this with all kindness to Meriden and Middletown, because we have been told in both those places, "We have a great many boys that ought not to have come here." "We have a hundred little girls," said Mrs. Brown, "who never ought to have come here. Now they are here we want to do the best we can for them." But, said she, "it is hard for them to find a place when they leave the institution." The managers of these institutions naturally like to see them prosperous. The more children they get the more money they have coming to them, the more *eclat* they give to the place, the better it is known. But it seems to me that when we send children to such an institution who ought not to go there we do them a great wrong.

I hope every farmer will interest himself in this plan with reference to the Prosser farm, make himself familiar with it, and try to help it on.

Mr. Little. I have been exceedingly interested in this discussion. The points that have been taken by these ladies are well taken. There are boys and girls sent to the Reform School who should not be sent there. I have had some experience in that matter, and I think there ought to be a reform in that respect, and this proposed farm may in part accomplish that desirable end. An officer brings a boy to the Reform School. "Why did you bring this boy here? Is he a bad boy?" "No; he is one of the best boys in our community." "Why did you bring him here?" "His father was killed at Fredericksburg; his mother has since died." "Is not that enough to break down a poor boy, that his father should fall in battle and his mother die, without bringing the stain of the Reform School upon him?" "Well, we did not know what to do with him.". "Why didn't you take him to the Orphans' Home for Soldiers' Children at Mansfield?" "I didn't think of it."

I feel very deeply interested in this matter. I have spent all my days in this work. No child should ever be sent to the Reform School until somebody has inquired into all the circumstances and ascertained that his conduct has been such that he deserves to be sent there; otherwise, some other place should be found for him. A large number who go to the Reform School had much better be placed on farms. Why should not you farmers open your doors and take in these poor orphan children, who have been guilty of no crime? Open your own homes to them; make them like your own children. Do not make drudges or slaves of them, but treat them as you do your own children. (Applause.) I believe that a Christian home is a far better place in which to train children than any of these institutions.

There are a great many boys and girls who ought to be at work at such a place as the Prosser Farm, the boys learning mechanical trades, learning the practical business of farming; the girls learning to cook, to wash and iron, and to be thorough housekeepers. I believe in making children self-respecting, not in making them feel degraded by the fact that they have been to the Reform School. There are many people who say, "We want to get a boy for the farm, but we do not want a boy from the Reform School; we do not feel that we could trust him." But let a boy come from such a place as the Prosser Farm, and he would get a place.

Mr. **Campbell.** This subject, which has been introduced by these ladies, is one which appeals to our human sympathy. We are all interested in it. We feel in our hearts that they have taken hold at the right place, at the right time; and it behooves us as farmers and citizens to do all in our power to cheer them and aid them in their efforts.

Rev. Mr. **Meech.** I am exceedingly interested in the subject that has been presented by these ladies. I was selected, some years ago, to be the superintendent of the Maryland Industrial School for Girls, not only because I was a preacher, but because I was educated to be a farmer. They wanted, as the president of the board said, a farmer-preacher to take charge of the institution. Great success attended our labors.

This work that is brought to your notice by these good ladies is one that I want to commend to the sympathy of every one of you. Give them your moral support, give them the support of all the influence which you can throw in the direction of their efforts, and give them the financial support which all such enterprises need.

Sec. GOLD. One word at this time, that ought to have been said a few moments ago. Our knowledge of the work of Mrs. Virginia T. Smith in placing children in families, is an earnest to us that that is with her the supreme idea,—that the home is the place of all others in which to train children. But the fact that there is a certain class which will be specifically benefited by an industrial training in such a school as this she accepts with us.

Gov. HYDE. Without any preliminary remarks, I desire to say that I have been very deeply interested in this paper of Miss Smith, and also in the presentation of facts by Mrs. Smith; and now I desire to offer a vote of thanks. I move that a vote of thanks be tendered to these ladies for presenting this subject to our consideration,—one which is of so deep interest to every father and mother, to every son and daughter in this land.

The motion was seconded and carried unanimously.

The Question-Box was again opened, and Secretary Gold read the following question: "Is tuberculosis or pleuro-pneumonia prevented or in any way modified by inoculation?"

Dr. CRESSY. Ever since 1843 it has been believed that pleuro-pneumonia is subject to protective inoculation, and experiments have been tried to a considerable extent in Europe within the last ten years, with a view to demonstrate that fact among others, by Dr. Fleming, the editor of the "Veterinary Journal," and the Veterinary Surgeon-in-chief of the British Army, who is a firm believer in the germ theory of disease and in protective inoculation. There is no doubt that inoculation is almost an absolute protection against small-pox. It is believed by Pasteur that tuberculosis may also be subject to the same modifying influence by inoculation, which will deprive the germ of much of its malignancy.

Mr. INGLIS. A year ago last December I visited my native country, and in the suburbs of the city of Edinboro' I visited a friend who had quite a large herd of dairy cows. I do not remember now how this subject came up, but he said to me, "Every one of my cows has been inoculated for pleuro-pneumonia"; and he said that one or two, it may be three, had died at the time they were inoculated. In other words, they were inoculated after the disease had developed itself. He had one cow that was sick at that time, and he said he did not know whether she would recover or not. I visited the herd two or three weeks afterward, and this cow was all right. Most of the herd were grade shorthorns. He pointed out to me one cow, and said, "I expect to get a premium at the exhibition for that cow." She was one of the cows that had been inoculated. I saw in an Edinboro' paper afterwards that my friend had taken a premium at the show of fat cattle in the city of Edinboro'.

Dr. JENKINS. Mr. Chairman and Gentlemen,—I have been asked to say a word with regard to the insecticides which are in common use, such as Paris green, London purple, or some powder containing arsenic. These have become of very common use among the farmers of Connecticut, as a means of destroying the canker-worm, coddling moth, and some other insect pests. It is not my object to say anything about the best method of applying these poisons, because I do not know anything about that.

The use of some substance which contains arsenic, usually either Paris green or London purple, is becoming very common among fruit-growers in Connecticut, to destroy the canker-worm, coddling moth, and some other insect pests. Those who have tested these insecticides most carefully endorse them most warmly. It is not my object to say anything about the best times and ways of applying these poisons. I do not know enough about that, and there are those here who do. I ask your attention for a few minutes to some notes on the composition and price of the arsenical poisons which are in market to-day.

*Paris green.*—This is a green powder, a double salt, as it is called, of arsenious acid (or white arsenic), acetic acid, and copper. It contains, when strictly pure, about 57 per cent. of white arsenic, 31 per cent. of copper, and 11 to 12 per cent. of acetic acid. It is probably arsenic alone which is its poisonous principle. There are, or have been in past years, several inferior brands of Paris green in market, costing less, to be sure, than the pure article, but relatively more expensive. From a number of analyses recently made at the Experiment Station,* we conclude that Paris green bought as "strictly pure" can be relied on. Paris green is made in this country by a number of firms, all of which are in an association to control the production and price. They will probably soon announce the prices for next year, and have already guaranteed that prices will be lower than last year. Paris green can be bought now by the single pound for 35 cents, and probably in considerable quantity for 28 to 30 cents, but not under that. It cannot be got of the manufacturers in 500-pound lots for less than 18 cents in bulk.

*London purple*, a purple powder, is a waste product from the manufacture of aniline dyes. It is an arsenite of lime, and has some dye-stuff and other matters mixed with it. It contains from 47 to 55 per cent. of white arsenic, and is therefore not greatly inferior in poisonous quality to Paris green. Its cost is *much* less than Paris green, retailing in New Haven for 15 cents a pound, and in quantity can be got for less than that.

*White arsenic* is pure arsenious acid, and therefore has from 1.7 to 2 times as much poison, pound for pound, as either of the other powders already spoken of. It costs at wholesale less than 3 cents per pound, and I am told by a reliable druggist, could be sold, if there was a considerable demand for it, for 5 or 6 cents a pound retail.

We have, then, these three things: Paris green, selling at 35 cents, London purple, selling at 15 cents, both equally good as insecticides, according to the statement of Prof. H. J. Cook of Michigan Agricultural College, who has had seven years' experience with them; and lastly, we have white arsenic, almost twice as strong, selling, or that *can* be sold, for from 5 to 8 cents a pound, and a very effective insecticide, according to Prof. Cook. But white arsenic has one very serious disadvantage, namely, its color is pure white, not different from that of saleratus, soda, cream tartar, salt, and other things used in cooking, so there is serious danger that it might be mistaken for these things, while London purple and Paris green cannot be mistaken for anything used in cooking. Arsenic should never be brought on to the farm as a white powder. Some years ago the State law of Vermont compelled druggists who sold white arsenic to color it with lampblack or charcoal before giving it to the purchaser. That was a wise law, and I wish it were in force to-day in Connecticut. If there is a demand for it, the druggist will, however, arrange to blacken it with lampblack before selling it. I have here a pound of white arsenic rubbed up with one-tenth of an ounce of lampblack, which is quite sufficient to make it look unlike anything eatable. At that rate a pound of lampblack, costing 35 cents, would color 160 pounds of arsenic, at a cost of two-tenths cents a pound.

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* Report Connecticut Agricultural Experiment Station, 1887, p. 142.

These statements show that London purple is at present much cheaper and just as good as Paris green, and that white arsenic is just as good as either, and could, if arrangements were made with druggists for it, be got cheaper than either of the other poisons. But let me say, as emphatically as I can, that any one is penny wise and pound foolish who will bring to his home arsenic in white powder. Either buy it colored, if it can be got cheaper than London purple, or let it entirely alone.

Mr. **Platt**. I would like to make some inquiries of Dr. Jenkins in regard to applying arsenical poisons to trees. Is it not absolutely necessary, after spraying trees, to keep stock for a long time away from under the trees? And again, how much is it necessary to use for spraying an ordinary apple tree, say from twenty to twenty-five years old?

Dr. **Jenkins**. I cannot answer from my own experience. In correspondence with Prof. Cook, he assured me it was not necessary to keep cattle out of the orchard for any length of time; that immediately after the application, unless they had rain, he preferred, as a matter of caution, to keep the cattle out of the orchard, but a single rain made it perfectly safe for cattle to go there. With regard to the methods of applying the poison, the State Pomologist can give much more accurate information than I can.

Mr. AUGUR. I will say that we have used Paris green and London purple, but have not used white arsenic. We have usually mixed about eight ounces of London purple with forty gallons of water, and sprayed the trees from that. A gentleman in our vicinity who has made quite a business of spraying trees by contract, has usually adopted this method, which has been very satisfactory both to himself and to his customers. He uses Paris green entirely,—that brand which is marked "strictly pure,"—and his method is to put a spoonful of the strictly pure Paris green into a pail, and then fill the pail with water. It mixes quite readily, and then with a Whitman pump, or some other instrument of the kind, he sprays the trees. He does this immediately after the blossoms fall, and after an interval of ten days or two weeks he repeats the process; and he says when he wishes to be absolutely sure he repeats it again. This makes three applications, and that makes it absolutely sure as an exterminator of all those insects, or nearly all, which trouble the apple. I will say that we used London purple this year on an orchard, and we mixed, as I said, about eight ounces of London purple with forty gallons of water.

QUESTION. How many pailfuls to a tree?

Mr. AUGUR. You can judge about that. It depends upon the size of the tree. We intend to give it a thorough drenching; anywhere from a pailful to two pailsful to a very large tree. But I was going to say that some of the neighbors laughed a little at me this year because the foliage was scorched a little, not enough to injure the crop materially, but enough to show that we had used it a little too strong. With a little caution in that respect, I think it perfectly safe and I think it very practicable.

Mr. **Lyman.** Something has been said about grass under the trees being injured by spraying them with Paris green, and as to the length of time which should elapse before cattle are allowed to eat it. My experience this last summer taught me a good deal in regard to that matter. I was told that after the first heavy rain it was always safe to turn in stock of any kind to eat the grass. We sprayed our trees about the first of June, and there was no heavy rain until about three weeks after. Then we had a rain of three inches of water, and, naturally, we thought the Paris green would be certainly washed off the grass, and we turned our cows in. Within ten days the milk began to taste bitter, and it grew more and more bitter, and the butter would not come. By-and-by we lost one or two calves prematurely, and one or two cows showed eruptions on their limbs. I then began to suspect that it was the Paris green. I took them from the pasture and the eruptions disappeared, and the milk of the cows immediately grew better, until there was no bitter taste, the butter came, and everything was all right. But I learned a lesson which I shall not forget. I think if the Paris green was enveloped by the leaves of the grass, that the water was not able to wash it off, and it remained there. I think the strength of the solution was about one pound to seventy gallons of water, so that I do not think it was too strong. I relate this experience, thinking that perhaps it may prevent some farmer from going through with the same experience that I did.

Prof. **Chamberlain.** I venture to guess that the gentleman who has just spoken must have overlooked some conditions in the quality of the milk from his cows, for it seems to me that unless the poison was used in the most excessive strength and in the most wasteful quantity, it would be impossible to produce such a result that the taste would disclose the presence of the poison in the fluid. With regard to the safety of using it and herding cattle upon the ground immediately, I would like to state this: that on the premises of the manufacturer of the pump which is commonly used for spraying in Meriden, at one time the gentleman sprayed his trees while his horse was feeding underneath them, and with no harmful result. It seems to me that there is no need of excluding cattle unless the poison is used in much greater strength than is required to exterminate the pest. But I would like to ask Dr. Jenkins to what extent Paris green may be diluted with gypsum, or flour, and the mixture still remain effective for the extermination of the common injurious insects? When I began to use it, I used one pound of Paris green to twenty-five pounds of plaster. Of course a single application taught me that that was altogether too strong a mixture. I then doubled the amount of plaster, making one pound to fifty, and with the same result. I then doubled again, using 100 pounds of plaster, and it seemed to me equally effective. I doubled still again, using 200 pounds, and found it as effective as before and less harmful to vegetation. The present season I have used one pound of Paris green to 300 of plaster, and found it as effective as either of the other mixtures. Now I would like to ask Dr. Jenkins what is the limit of dilution?

Dr. JENKINS. I have had no practical experience myself, but the testimony of Prof. Cook, who has had long experience, is that it is very much more efficient as an insecticide where it is very largely diluted than when it is stronger. The reason is that where it lies in considerable quantity on the leaf, the insect will naturally avoid it, and making it more dilute makes it more likely that the insect will devour it. Prof. Cook said that he had used one pound of the poison to 100 pounds of gypsum, and had also used one pound to 200 pounds of gypsum, and found the latter mixture equally effective. He said he should certainly rather make it less strong than stronger.

Prof. CHAMBERLAIN. I have found that one pound mixed with 300 pounds of plaster was a sufficient quantity for an acre and three-quarters of potatoes, and in my own experience I have found the dry mixture the most economical, for, as a rule, our fields are located at a distance from any point at which water can be obtained conveniently, and the removal of the quantity of water required to spray a field of potatoes costs us a great amount of labor. We can transport the mixture in a tub or barrel on a wheel-barrow and save a great deal of time, and then by a very simple contrivance it can be applied almost as rapidly as a man can walk.

Mr. **Ayer**. How many applications for the season?

Prof. **Chamberlain**. The beetle has been particularly vicious with us the present season, so that we have made three applications, each time exterminating every insect that we could find on the field. I have found that others have had the same experience.

Mr. **Olcott**. I would like to ask Dr. Jenkins one question. I believe the station has analyzed what is known in our markets as "slug shot". Prof. Chamberlain of the Storrs' School has shown us that 300 pounds of plaster can be sufficiently poisoned with one pound of Paris green, and Dr. Jenkins has shown us that ten cents worth of white arsenic and lamp-black will poison twice as much plaster. Now I wish the relative price of "slug shot" might come out, that we may know what we have been taxed to abate the potato bugs.

Dr. **Jenkins**. The gentleman is in error. We have not been called upon to analyze "slug shot," or "dead shot," or whatever it is, in this State. It has been analyzed at the Maine Station and found to contain very much less arsenic than either of the other articles which have been referred to. I have forgotten the exact figures, but my impression is somewhere about ten or twelve per cent. The manufacturers claim that it contains an oil which is supposed to be perfectly destructive to bugs, but with regard to its destructive effects I know absolutely nothing. It would seem that London purple or white arsenic was altogether the best insecticide.

Mr. **Lee** of Guilford. I have used slug shot on potatoes with success. I have used it this season on currant bushes and destroyed the currant worm. It did not seem to wash off from the currants, but it killed the worms. I tried some of the currants myself, after washing them, and no bad effect followed.

Secretary GOLD. "What is the best grain ration for the production of butter?"

Capt. SCOTT. My business is the production of butter, and the best grain ration that I have ever got hold of is two-thirds oats and one-third Indian meal. I have fed buckwheat bran once in a while to get milk, but not butter.

Mr. HOTCHKISS. The question of what will produce milk and butter is one of great importance. I am very glad to hear that the subject will be thoroughly ventilated at the Dairymen's Convention which will be held later. I have found, while making milk for the Waterbury market, that by mixing eighty pounds of buckwheat bran and sixty pounds of wheat bran with the same quantity of corn meal which I was feeding before, my cream gauge showed a loss of four per cent. of cream in two days, with the stable at the same temperature and the cows in the same condition in every particular.

Secretary GOLD. "Will the drying of an injured teat permanently reduce the secretion of milk one-fourth?" It will not. If this teat is dried off in such a way as to inflame and swell up, it often will so affect the health of the cow as seriously to diminish her milk, but if this teat is dried up in such a way as not to produce any such effect, a three-teated cow will give as much milk as one with four or five or six teats.

QUESTION. "Can anyone inform me which are the best potatoes for seed, large or small? How should potatoes be cultivated?"

Mr. THERON E. PLATT. I should not plant the very largest. My idea in selecting seed is to select the most perfect tubers from the most prolific hills. The most *perfect*, not necessarily the largest. I always cut to one eye, or at most two, for drill culture. For hills, I should not cut them as fine. I select the seed at the time of digging; that is the only time that you can get them from your most prolific hills. Flat culture, planted about four inches deep, is my rule. Fertilization depends on the soil. My plan would be to take a clover sod and plow in the fall, perhaps September, and harrow it two or three times in the spring, and then replow it. Then

I should furrow it out four inches deep and three feet apart, drop my seed and cover it up. Keep the ground nearly flat. I always sow the fertilizers broadcast in my practice. I usually make two applications, one before planting and the other when the potatoes are in blossom. The last time I put it between the rows, not in the rows. I had a pretty good experience this summer in an experiment I tried to show the difference between flat culture and hill culture. I engaged a man to hoe the potatoes and clean out the weeds. I did not say anything to him until he had got over perhaps an acre and a half, where he had made very nice ridges. I told him not to hill them up any, and the rest of the field was left flat. I did not get two-thirds the yield of potatoes where he ridged them up that I did where they were flat.

QUESTION. What implement do you use in cultivating?

Mr. PLATT. I use a smoothing harrow at the start; after that, a Planet Jr. cultivator. These are the best things I can get. We do not have to do much weeding ordinarily. This past season has been a great season for weeds. Ordinarily you can get rid of them with a smoothing harrow.

QUESTION. Are farmers getting enough for their milk — those who sell to milkmen?

This question was put to vote, and there was an almost unanimous "No." One gentleman, however, shouted "aye," and explained his vote by saying, "I live in the city and have to buy milk."

Adjourned to evening.

## EVENING SESSION.

The meeting was called to order by Vice-President Day, at seven o'clock.

Secretary GOLD again opened the Question Box and read the following: "Is there any remedy for the white grub that eats grass and corn roots?"

Mr. ———. Turn in your pigs and let them take care of them.

Captain **Scott**. Salt will do it.

Secretary **Gold**. Sometimes they eat strawberries. How is that, Mr. Augur?

Mr. **Augur**. I find the white grub more common in newly-turned sod, and before planting strawberries I like to have the ground kept under clean culture for two years; then it will be free from the grub. It is a great pest. I think we lose very largely of our grass from the grub. I do not know of any remedy.

Mr. **Olcott**. I merely want to say, when you see the crows in November holding conventions on your pastures and meadows, let them alone.

Secretary **Gold**. That was just in my mind when Mr. Olcott rose.

Mr. **Olcott**. I am very glad to get your support, sir. I do not often have a chance to do it.

Colonel **Warner**. I would like to make a single inquiry, and that is, if any farmer here has had any trouble from those grubs on rich turf land?

Mr. **Augur**. I should say that we have had as much on such soil as on any other.

Colonel **Warner**. In our vicinity that worm almost always appears on poor soil. If we plow it up and manure it highly they disappear, so that they do not trouble us. I have never seen this grub worm in my locality trouble rich turf land.

Mr. ———. My experience is, the more manure the more grubs. They live in the manure.

M. ———. In the Connecticut River meadows we have the most grubs on our strongest and richest turf land. I have seen them so thick after plowing in the fall that the whole surface of the land appeared white with the grubs. If we plow late, just before a heavy frost, it destroys most of them.

Secretary **Gold**. Some years ago, in one of the richest and best pasture fields that I had, the grass was nearly all killed in June. We turned it over, and found that the roots were largely consumed by the white grub. We planted sowed corn and had the most wonderful growth that we ever raised of that article, showing that the soil was not exhausted. It was not the lack of fertility, but the grubs were there in abundance.

QUESTION. "Has any one had any experience in making cheese with the skim-milk raised in the Cooley creamery?"

Secretary GOLD. Cheese making is almost a lost art in Connecticut. I am afraid we shall get no response to that question.

QUESTION. "What is blood poisoning?"

Dr. CRESSY. That is quite an indefinite question. Any disease resulting from a *post mortem* examination would be considered blood poisoning. If it was a case of glanders, and you should catch it, it would be called blood poisoning. Blood poisoning might also affect the system of the individual who had a bad sore; the effect might spread through the system, and it would be called a case of blood poisoning. An instrument used upon one patient might give blood poisoning to another. The phrase is not explicit; you may have as many phases of blood poisoning as there are of disease.

Secretary GOLD. "Can the common farmer discover tuberculosis in garget?" Will Dr. Cressy please answer?

Dr. CRESSY. I believe that a large number of the so-called cases of garget are really tubercular affections. I have not any doubt of it, for I have made *post mortem* examinations of a good many animals where it showed itself. But when you have one-quarter of the udder affected with the garget, and that should turn out on examination to be tuberculosed by showing the *bacillus tuberculosis* in the centre of the tubercle, it might be hard work for the average farmer to diagnose that case; it might require the best expert to decide the question. But ordinary tubercular garget would not be attended with the inflammatory condition which would usually attend a case of mammitis, which is inflammation of the glands. In that case there would be excessive heat in the part affected, and it would show a redness and tenderness which are characteristic of the old-fashioned garget, while you would not get that in the case of ordinary tubercular garget. But if you found the hair of the animal staring towards the horns, the creature emaciated, and more or less cough, I should fancy that in every such case the disease would be tubercular. The milk of such an animal ought to be thrown away.

The question has been asked me by a dozen persons since yesterday morning whether if a cow has any trouble in the lungs, and only in the lungs, with a trifling cough, whether that will affect the milk. I stated in my address here yesterday morning that it would not. The best authorities say that a tubercular deposit in the lungs does not interfere largely with the animal economy, and does not affect the milk until the udder itself is involved. The hunt of microscopists to find the bacillus in the blood has been almost a failure. They have only been found in those cases where we have an affection of the udder. The blood, like some of the secretions of the body, does not contain the bacillus; it is only in those places where tubercles are found that we get them.

QUESTION. "Can tuberculosis be communicated to a person by opening an animal dying of the disease?"

Dr. CRESSY. Yes.

QUESTION. "Will horses take it by eating the refuse from the manger of a cow?"

Dr. CRESSY. There never has been a case of tuberculosis known in the equine race. If there is any case of it, it is where we get those little isolated hard lumps within the lung that are very small and perfectly enclosed, so that they will not go any further. But I never saw the lung of a horse broken down like that of a human being, or that of a cow. Tuberculosis, as such, does not exist in the horse, but the apparent manifestation of it is in all probability due to glanders.

QUESTION. If a man should take it through a wound in his flesh, would it go on to his lungs and operate like blood poisoning?

Dr. CRESSY. If he should get it in his finger he would naturally become locally affected. It might be cured there either by amputation of the finger or by the injection of certain substances to prevent its extending through the whole body. I should fancy it would not become general until the system was pretty generally affected, which might take some time.

QUESTION. "What are the first symptoms indicating that a cow has tuberculosis?"

Dr. CRESSY. Ordinarily, a cough.

QUESTION. "What is the remedy for lameness in a valuable horse caused by fouls in the foot?"

Dr. CRESSY. Cure the fouls. Clean out the foot with a blacksmith's knife; cut it out as well as you can, and apply to it, if you have nothing better at hand, dilute carbolic acid. Sometimes salt thrown in will do it. Petroleum, spirits of turpentine, any one of a great many things thrown in there might have the desired effect. Apply a poultice, and the lameness, if secondary, will all disappear. Keep the leg well bandaged, and apply a liniment.

The quartette again gratified the audience with a song, after which the chairman said: The subject of the lecture this evening is "The Carrying of Farm Products," by Professor William H. Brewer, whom I have the honor of presenting to the audience (applause).

## THE CARRYING OF FARM PRODUCTS.

By WM. H. BREWER.

The selling price of farm products is regulated by the law of supply and demand. Taken as a whole, and in a wide sense, they form no exception to the great economic law which governs the prices of all articles of sale and commerce, but in certain very important particulars they are so unlike many commodities that farmers often come to believe that some different law or set of laws governs them.

Unlike most other productions there is *always* a demand, a daily demand, an imperative demand. Of most of the commodities on sale in the world, one can do without them, for a time at least, if the price does not suit the buyer, but everyone must have his daily bread. The farm supplies this, as it does the material for the clothing of the world. The demand for farm products is therefore always sure and certain, considered as a whole, and this demand cannot cease so long as civilization lasts, and there are mouths to feed and bodies to clothe. Moreover, the demand must grow with every increase of population, for population cannot grow without food.

We may also say, in a general way, that there will always be a supply, for, as a whole, the supply must keep pace with any changes in the number of people. The limit of population is determined by the limit of food. Food supply and population must be mutually related, and, bear in mind, the farm is the source of the food supply.

So there is a sense in which we may say that there will always be a demand, reasonably constant, and always a supply which is somewhat variable, and that the price of the crops in any one year will depend upon the comparative excellence of the crops of that year. In theory, and as a whole, this is true, and the matter of prices is a very simple one; but in the experience of the individual farmer the case is not nearly so simple. The price depends, in part, on how anxious the consumers are to have his especial crop, but it depends much more upon his facilities for getting it to them. This is now the controlling factor in the selling price, at the farm, of all staple crops. Once it was more a matter of tillage and farming, now it is chiefly a matter of transportation. Formerly it was how to grow the crop for consumption near by, now it is how to transport it to some one farther off.

Within the memory of some of the elder persons whom I see before me in the audience, greater changes have taken place in the facilities of land transportation of farm products than in all the ages that have passed since the crops of Abel and Cain were not favored alike. The changes that have taken place in transportation within a lifetime have had a more profound effect on the practice and remuneration of the individual farmer than all the other causes combined which have been at work during the same period, great as the others have been. These changes have occurred faster than the farmer can keep up with, and he has become frightened.

Until the present generation, the great bulk of farm products, the food products, I mean, was, and had to be, consumed near the place of growth. The farmer had practically to have a home-market, if he had any at all; for the great bulk of his crops, he knew where his market was, and who were the consumers. A considerable part he sold directly to the consumers, without the intervention of any middleman, and of most of the rest not more than one person stood between him and the consumer.

Now, he does not know where his crops ultimately go, nor who consumes them ; he only knows that they, after going through the hands of many middlemen, are scattered, it may be, to the very antipodes.

Formerly, his competitors as well as his customers were his own neighbors, now he has the whole world for his market, and his competitors, too, are scattered in all lands.

And yet, with all this widening of the market and apparent increase of consumers for his crops, the ordinary farmer has less choice of market to-day than be had then.

Until within a very few years the great bulk of the food for the world had to be grown very near the place of consumption. The more bulky vegetables, within a dozen or twenty miles, grain within twenty to forty miles, or near some place of shipment by water. There has been some commerce in grain from very early times, but only in any quantity by water (the famous shipwreck of St. Paul was of a vessel carrying wheat from Alexandria to Italy). Meat could come from somewhat farther, cattle being driven across the country. Condiments, spices, and a few costly luxuries might come from distant countries, but the great bulk of the food had to be produced near to where it was eaten. The great mass of people had to live near the farmers who grew the chief supplies for their tables, and such great cities, as we now know, did not exist, and were impossible. So many people together, could not be fed. Now the problem of feeding cities of any size is solved ; food can be carried half way round the world ; the problems of city life and of farmers' markets have all been changed, and they have been changed faster than the farmer could adjust himself to the new conditions.

Railroads have been the great factor, so great that we forget that some of the old factors still remain. Railroads chiefly facilitate the transportation of farm products on a large scale. They bring the wheat fields of Dakota nearer the tables in New York and London, but they do not bring the individual farmer any nearer the place where he sells his products. The ordinary farmer must still get his crops away from the farm by wagon and over common roads, to his actual market, just the same now as he did before railroads were built, and the average farmer has not yet awoke to the fact that good country roads are now even more of a necessity than then.

Most farm products are bulky and heavy, and their transportation by wagon and team is expensive. Only some of them can be hauled more than a very few miles unless the prices are very high, and consequently, before the day of railroads prices of the same product varied enormously in different districts of the same country in any year, or in the same place in different years.

Most of the farming of the world is mixed farming, in which the farmer grows a variety of crops. No crop grows equally well all years; every year some of his crops do not pay him for his labor. In former times, when bulky products could not be carried far, the extra profit of his good crops paid the losses on the poor ones, and indeed the scanty crops brought locally a higher price, and these conditions helped compensate for bad years.

Now, an especial scarcity in one place is supplied by crops grown somewhere else where the season has been more fruitful. The farmer is therefore doubly unfortunate in his poor crops; the quantity of his product is lessened, but the price is not correspondingly enhanced; in his case the old law of demand and supply has been interfered with. The law is true when applied to the whole grand total of farmers, but to him and his neighborhood, the diminished supply has not correspondingly increased the demand.

We see this, just now, strikingly illustrated with potatoes. Twenty years ago, in lecturing to my students, I demonstrated to them how the railroads affected the New England farmer in the relative matters of potatoes and grain — how that grain could come from the far West, but potatoes could not. That was true then, but a few years later, I bought potatoes for my table right from the car into which they had been loaded beyond the Missouri River. Now, they are coming from Europe. This very month I have noticed the reports of importations of potatoes from Germany, Belgium, Holland, Denmark, Ireland, and Scotland. Even more bulky food, as cabbage, crosses the Atlantic, and such perishable food as fresh meat is carried half way around the globe, if it can only be got to the place where steam can move it.

But let us keep before us that hauling by wagon is just as expensive now as it was before the days of steam. Farm products are just as bulky, horse flesh just as dear, and as a consequence only a few kinds of crops can be hauled over the country roads more than a very few miles, unless prices are very high.

Where merchandise is transported over great routes by wagon, and where "teaming" is a business, it is easy to get at the cost. Before the days of railroads great wagon road routes were a feature of every country, and there were established rates of freight. But it is not so easy to get at the cost, to the farmer, of transporting his own products to the place of sale, by such means as he has, and over such roads as lie near him.

In the preparation of my report on grain production, for the last United States census, I made a special effort to find out this very thing. I sent a schedule of questions into every county of the United States, and into many counties more than one. One of the questions was as to the cost of hauling wheat from the farms to the place of sale or delivery, by wagon, "as the roads usually are when the grain is shipped." So far as I know, this is the only attempt, on a large scale, to get at the cost to the farmer of hauling his stuff on the country roads of the United States. Unfortunately the question was asked only for wheat, and as a consequence I got answers only from the wheat growing regions, and the question was not as generally answered as I had hoped. Out of the thousands questioned, I received only about 350 answers that were available for my use in this connection. These answers, however, came from many States, and represented widely different regions, and they were curiously variable. The cost varied enormously, or at least the farmers thought it did. The cost ranged all the way from two mills to two cents per bushel per mile. About one-fourth of the estimates were at about one-half a cent per bushel per mile; about one-third were from six mills to a cent; the remainder, or about forty per cent. of the answers were either below a quarter of a cent or over a cent, ranging up to two cents. The cheaper ones were where the lands were level and the roads good. And only under the best conditions would it pay to raise wheat in the United States, if it had to be hauled twenty miles to place of sale or shipment.

Now, this great expense of wagon transportation applies to all farm products, except those that sell for a large price per pound, such as butter, and similar costly things. It shows why, in former times, cities could not grow large, and why the consumer had to live near the producer. For example, it is, in round numbers, 1,000 miles from Minneapolis to New York. To haul wheat that distance, at half a cent per bushel per mile, would cost five dollars per bushel. But in reality, wheat now comes vastly farther, and the railroad carries a ton per mile at about the same rate the farmer carries a bushel per mile under the best circumstances.

When I was a boy, and on the farm where I was reared, wheat sold for seventy or eighty cents per bushel, but my father grew much clover seed. The seed was nice, clean from weed seed, and he would sometimes take it 200 miles for sale. Starting with forty or forty-five bushels, selling a part in the next county fifty miles away, the remainder would be carried to the Hudson River counties where it brought sixteen dollars per bushel. But only concentrated, precious products could be so carried, and even those must be produced on a considerable scale. The farmer who grew but ten or fifteen bushels of clover seed could not afford to make the long trip.

In those days it was easy to see that such a transportation depended entirely on the character of the roads. But now that farm products are carried long distances on railroads, the fact is lost sight of that most of the hauling then, as now, was for short distances, and that now good roads are of even more importance than then, because farm competition is so much closer.

Good roads are one of the first essentials for a high civilization. It has been so in all ages, it is so now. There can be no great nation unless it has means of intercourse between its parts, and the very fact that railroads now offer easy means of travel and transportation for great distances, gives new importance to the local highways that lie between the farm and the railway, or the farm and the town.

The Romans built great roads as they extended their empire and their dominion. They were a military necessity, but they had their other uses and were a great factor in civilizing the peoples they conquered. And when Rome fell, the roads became poorer, and this was one of the causes as well as one of the effects of the dark ages which followed. It made the gloom deeper and increased the difficulties of the new civilization which followed. Macaulay and other historians have told us how bad the roads were in Great Britain in the last and in previous centuries. How that farm products had to be carried on the backs of pack-horses, except cattle which might be driven on foot, and how slow travel was generally. When the Highland Agricultural Society came into existence in 1784, it found the great obstacle to improvement on farms to be "the want of means of internal communication." "The defects of the public roads then in existence operated most prejudicially to the farmers who sent their produce to market." It limited the production and prevented the replacing, by manure, of the elements of fertility which was abstracted. The turnpike act went into effect about 1760 or 1765, but it was not until well into the present century that good roads became common enough to allow English and Scotch agriculture to take the high stand the middle of this century found it. A prize essay, on the changes in agriculture during the previous fifty years, published in 1840, in the *Farmer's Magazine*, brings this out most strikingly, how the improvements in roads led to progress in agriculture.

Most countries of Continental Europe have built roads for military purposes, which became great factors in the development and progress of the countries in times of peace. Napoleon had the first wagon road built over the Alps, that cannon and armies might move the easier. Now that four tunnels pierce the Alps for railroads, for peaceful traffic, the country finds greater need than ever for good local roads.

Military roads have been built by every civilized nation on earth, I think, and in the end the roads proved of more importance to the arts of peace than they did even to war. The great "National Road" built by our general government from Baltimore westward across the mountains to Wheeling, thence to Cincinnati and St. Louis, was a great aid in building up the West, and was for a long time a great route of travel and inland traffic. So long as western outposts were disconnected with each other and with the outer world by roads, they could not grow.

The difficulties of early transportation in this country has long been an interesting study to me, and many curious facts have come to my knowledge as I have pursued this inquiry. I lived two years in western Pennsylvania in the region of the famous "Whisky Rebellion" of 1794. That grew out of the difficulties of the transportation of a farm product. There were no roads over the mountains, grain could not be carried profitably to the markets, but whisky could, and by its sale necessary articles were bought. "An unpopular excise tax," is the usual cause given in school histories of this rebellion. The farmers and participants gave as their reason, that it was an unjust discrimination against the only product of their farms which they could carry to a market. When, later, they had good roads and their products could be got out, they were loyal enough.

What prevented the West from being earlier settled was this very want — when the settlers did go, the great problem was, what could they send to market with which to buy certain necessities of civilization which they could not themselves produce. Silk and such precious commodities were tried. My father emigrated to Central New York when the journey from the Hudson River took as much time and required as much or more trouble and fatigue than does the emigration to Kansas or Dakota to-day, and the most vivid recollections I have of the stories I heard told in my childhood by the earlier pioneers, were not of fights with Indians or wild beasts, but fights with hunger, and the difficulties of getting things through the wilderness; how potatoes, for seed, had to be brought great distances on the backs of animals, and how the hungry children dug them up to eat after being planted, and such like stories.

All this is but one phase of the transportation problem. I dwell on it for a purpose, as part illustration of the former difficulties of the transportation of farm products, and of the difficulties of feeding communities which were not scattered on the very ground which was to feed them. And this brings us back again to the difficulty of feeding large cities. This could be done only where the food could partly be brought to them by water. There could be no great inland city. The largest ones then would be reckoned as tenth-rate towns now, and all this chiefly because of the imperfect means of transportation between the farmer and the consumer of his crops.

Farmers might have grown more food, and cities might have grown larger if the farm products could have been more readily and cheaply carried. The reaper, therefore, and like labor-saving machines, did not come into use more readily because the farmer really did not need them. The reaper became of value only after steam transportation began. It had been invented half a century before, identical in principle with that later used, but there was then no place for it.

At the beginning of this century no city of Christendom had a million of inhabitants; only a very few had a quarter of that number, or indeed had over a hundred thousand. The difficulties of feeding the people, and the frequent pestilences kept down the numbers. Now that steam carries the food and sanitary science furnishes means to prevent great plagues, cities can grow to any size that business calls for and will support. The two great factors, supplying food and controlling plagues have both been solved, in theory at least.

Let us look at this still further, as illustrated in the experience of this country. General Walker in his census reports has given us a most interesting discussion relating to the relative proportion of our inhabitants living in the country and in the large cities.

At the time of our first national census, in 1790, only $\frac{1}{30}$ of the population of the country lived in cities of over 8,000 inhabitants. That is, twenty-nine persons lived in the country or small villages to each one in a city of 8,000. In 1800 the proportion was $\frac{1}{25}$; in 1810 and 1820 about $\frac{1}{20}$, and notice how slowly the proportion of city population gained even in that prosperous period; in 1830, $\frac{1}{16}$; in 1840, $\frac{1}{11}$. Now the railroads began to tell during the next decade, and in 1850 it was $\frac{1}{8}$; in 1860, $\frac{1}{6}$; in 1870, a little over $\frac{1}{5}$, and 1880, about $\frac{1}{4}$. It is probable that another fourth lived in the larger villages and in cities of less than 8,000, but there were then over one hundred cities of 20,000 or more inhabitants.

These figures show very impressively the relative growth of city populations, with all the new problems involved, problems in politics and morals, as well as in agriculture.

Then again, not only did most of the people formerly live in the country, but a vastly larger proportion of those who lived in the towns and villages raised a part of their own food. The villages were more open, nearly every householder had his vegetable garden, often of considerable size, and the professional man or merchant had a few acres, if not a small farm. The mechanic, too, had, usually, his bit of ground. The well-to-do doctor or lawyer kept a hired man, and from his "little place" might raise more than his table or his pigs needed, and have a few bushels of potatoes or corn to sell. Many had a pasture lot and kept a cow, only the larger towns had milkmen. Nearly every family had a pig or two and a flock of fowls, and there was nothing in the sentiment of the times, or in the ethics of the professions to prevent any one from selling any small excess he had, at retail, to his neighbors.

The late Judge Foster of New Haven, has told me that in his boyhood, his father had no cow, but bought milk from two near neighbors who kept a couple of cows each, and having more milk than was always needed in their families, accommodated the neighbors, and so, "a part of the time we got our milk from the judge of the Supreme Court, and the rest of the time from the president of Yale College," each of whom milked his own cows, when the exigencies of the family made it necessary, and thought it not beneath his social or professional dignity to sell to his neighbors what was not needed for his own table.

The difficulties of transportation in those days made this small cultivation by such a large proportion of the people, a necessity of the times, and thus, not only were there relatively more people in the country, but a relatively less amount of the food was grown by the farmers themselves, so much being grown by mechanics and men in the trades and professions.

This distribution of production, at the door of the consumers, made it possible to get along with poorer roads than are needed now.

Then, too, there was then less travel. There was less driving for pleasure, and the necessary travel was less, as each neighborhood, not only grew a larger part of its own food, but had within itself more of the various necessities of civilization. There was the country shoemaker, blacksmith, wagon-maker, tailor, harness-maker, store-keeper, and so on; it was not necessary to go to a town or city several miles away for any of these.

As a consequence of all this, each neighborhood was more provincial, had more peculiarities of speech and had ways of its own. There was also another effect which is closely related to this subject. There was less variety of food and the people generally lived very much poorer. The prejudices which were fostered by their provincialism greatly increased this evil. For example, the tomato, which is especially fitted for garden cultivation, was known and eaten as a food, and highly recommended long before the pilgrims landed, or even before the settlers came to Jamestown, yet many of the audience present can well remember when this vegetable came into common use in this State. The potato, although a native of America, was sparingly cultivated in New

England until after the Revolutionary war, and did not take its present place on the table until in the present century. We have a still better and more familiar example in oatmeal. That has been a staple article of food in some countries from time immemorial, but for some reason incomprehensible to me, it did not spread among the colonists, and down to 1865 I had never seen it used on the table of any American family, nor so far as I can remember, had I ever seen it on the bill of fare at an American hotel or boarding-house, although fifteen out of the previous seventeen years, I had lived in boarding-houses and hotels. Now, its use is universal, it has penetrated to the most distant settlements, and grocers tell me that they now sell barrels of it where they sold but pounds twenty years ago.

Such former restrictions of kinds of food, imposed by the prejudices which grew out of the provincialism and the restricted intercourse of the times, affected the farmer in that it locally enhanced the prices of the production which might be short on any year, and thus helped him get some compensation in higher prices for any poor crops. Now, with our greater variety of foods, a scarcity of one means increased consumption of another, whose price is not temporarily raised. The food question, in any one family, was then much simpler in theory, but it was vastly more difficult to solve in practice. A multitude of causes and conditions were involved, but the most of them were in some way related to, or dependent on, the transportation problem.

In years of scarcity of some particular crop, many tables had to go without that kind of food, and in bad years in any neighborhood there might be positive suffering and want, even among people not wretchedly poor. The people had poor roads, and the poor roads were an important element in keeping the people poor.

The last quarter of the last century and first quarter of this, was a period of wonderful intellectual activity, which was more especially manifested in the growth of the physical sciences, and consequent invention, and in the spread of learning. These brought on great political and economic revolutions. The sciences of chemistry and geology, so rich in practical applications, had their birth and grew rapidly into shape and usefulness. Cotton came to be the great commercial plant, the steam engine came into common use, and coal came to be a common source of power. These several factors led to a rapid and enormous development of manufacturing towns and cities. Before that, manufacturing was scattered, and the establishments were small. Under the new conditions, manufactures were cheapened by increasing the size of the manufactories, and the growth of manufacturing cities followed as a consequence. These cities had to be fed, and for this better roads were needed and came rapidly into being in the Old World, less so here. The growth of the towns necessitated better roads.

This demand for better roads was not the demand for an increased luxury for the rich, but a necessity for the poor. It was the growth of manufacturing in cities that made better roads a necessity. It took place on a grand scale with the growth of such cities as Manchester in the Old World, it took place just as truly here, but more slowly and pursued a little different course. The principle at the bottom was however the same in both cases.

The mechanic who before lived in the country or small village, went to the larger town, and the doctor, and lawyer, and merchant followed him. They all had to be fed in their new home, the food had to be carried farther, and the work which the farmer had heretofore had of the artizan, who was his neighbor, he had now to go to town for. All this required road travel, but it was the food problem that remained the most serious. The amount of food used was just as great, it was just as bulky, and just as heavy. The cities for a time grew faster than the means of feeding them did, and want stared them continually in the face.

When we read or hear of the dreadful condition of the manufacturing cities fifty years ago, the long hours the operatives had to work, of their miserable fare, our sympathies are moved and we often feel like blaming somebody, but the trouble was chiefly in the difficulties of carrying food. It was not the tyranny of capital as demagogues would have us believe, but the price of freight. The operatives live better now, and work fewer 'hours, not so much because of trade's-unions, and strikes, and secret aggressive societies, as because of railroads which enables a large city now to have its bread, and its meat too, brought from great distances.

I may say in parenthesis, that these former hard conditions led to much sickness, and pestilences were liable to often occur, and, that as commercial facilities spread, the danger of pestilences became greater, and at the same time they became greater calamities to business and prosperity. So when the cholera visited Europe and America in 1832, the business world felt it even more than the philanthropic world did, and the prevention of pestilence became a business necessity. This brought sanitary science into existence, and public sanitation, according to scientific principles, has now become a necessity in all cities. There were rules of private hygiene before, but not a science of public health. The development of commercial prosperity demanded it, and now health boards are supported in all our cities, not so much from motives of humanity, as to the fact that no city can afford to have a serious epidemic. Health boards, particularly if they do their work well, are only grumblingly supported by the politicians, yet they, as well as railroads, have played their part in changing the practice of the farmer. They have helped to make great cities possible.

These changes have gone on faster than the farmer has changed his methods and his practice. He has to feel his way, as it were, and suffers while experimenting. The distress is greater in Old England than in New England, because agriculture there is more complicated and more difficult to change. But the necessities for change do not all exist on the farm itself.

In no other one thing have the farmers of New England stood still so much as in making and sustaining roads. Historians and engineers who tell us about the roads as they were formerly in Great Britain, what their defects were, why they were so poor, how they were supported, and so forth, seem to be telling about the Connecticut of to-day. We imported the means and methods of the last and the previous centuries, and have scarcely improved on them.

The old dirt road, mended only by the farmers of the neighborhood or "district," and under their control, a system brought from the Old World long ago, is still the rule here. We have introduced steam, and railroads, and reapers, and so on, but we stick to the old roads and to the old methods of repairing them. I believe that better country roads is the one first thing to improve the condition of farms and farming in Connecticut.

I am inclined to think that it would be better if the roads were under the management of some larger organization than the district or the town. I am not clear as to whether it had better be with the county or the State, but with the light I now have, I think it would be better for the State.

The building of roads and keeping them in repair is a technical business. It is both a science and an art; it is something that has to be learned, and can be well done only by experts.

A selectman may be a good road repairer, just as he may be a good farmer or a good shoemaker, but the chances are that he is not. The making of *good* roads cannot be entrusted to any politician any more than the making of a good wagon to travel on it, or a good shoe to walk on it with. Then too, the division of responsibility among the towns is not conducive to good roads. One thing seems to me so plain that I only wonder that it ever existed after the first trial. Roads *cannot and will not be kept in good repair by contract.* City streets can be *paved,* and roads may be *built* by contract, "according to specifications," but when it comes to keeping a country road in repair by contract, it is practically impossible to have the work well done. "Keeping the roads in good repair" and "in good traveling condition" is not a specification that is sufficiently exact to hold. The contractor takes the job to make money, and his understanding of the phrase may differ widely from that of the public. "Work on the roads" has never been practiced for pleasure; it is a hard, unromantic, uninteresting work. so much so that it is common to set criminals to do it, and the ordinary contractor takes the job for what he can make out of it. Of all devices which the evil one has suggested to the selectman whereby he could nominally discharge his duty and shift responsibility on some one else, the letting out the repairing of the roads by contract seems to me to be one of the most eminently successful.

Then, again, many well-meaning people entirely mistake the object of a good road. It is to facilitate and cheapen transportation; but many people, even those in authority, think that it is more especially for "those who keep carriages." This mistake of some good people is a common cry of demagogues, who would have us believe that money spent in making roads *good,* is to increase the luxuries of the rich rather than relieve the necessities of the poor. I hear this all the time about New Haven, whenever it is proposed to have better roads into the neighboring towns. "If the rich people of New Haven want good roads for their carriage drives, let them build them themselves," I have heard over and over again, as if there were not half a dozen business wagons, milk wagons, truck wagons, etc., to every pleasure carriage.

Good roads help all, but they especially help the poor. Take the streets of a city. I remember hearing men in my own city object to paving the streets because of the expense, they kept no carriage themselves, and so on. Before paving the street I live on, half a ton of coal was the usual load; now a ton is the common load. The time and cost saved pays for the pavement many times over.

There are probably a hundred milkmen coming into our city daily, and probably this one business alone necessitates an aggregate of a thousand miles of daily travel. When we consider the hours at which much of this is done, and the great difference between the cost of travel on a good and on a poor road, this makes an enormous total in a year. Talk about long journeys, why, I suppose that the milkmen alone, travel in and about New Haven, enough to go around the earth every month! — you may calculate it up for yourselves — and would find 25,000 miles too little — and this is but one kind of traffic, and an humble one at that. It can be easily demonstrated that the aggregate amount of business travel on the roads within fifteen miles of the center of any one of the cities of this State would amount to a great many millions of miles annually. Then consider the aggregate mileage of wagon travel over the roads of Connecticut. If we could but know what it really is, see it in figures as railroads show their mileage, and if we could then contrast what all this costs as the roads now are, with what it would be if the roads were as they should and could be, it would need no lecture nor essay. The farmers would rise *en masse* and demand that this great hindrance to progress be removed.

There is another item I wish to speak of in this connection; that is, the use of wide tires for wagons. In Europe, on the toll roads that I knew thirty years ago, wagons with tires more than four inches in width paid no toll; they improved the way rather than wore it out. I have heard that in former times similar rules existed on some American turnpikes. I think that with a movement for better roads, and better sentiment about the protection and preservation and repair of country roads, Connecticut farming may come to the front again.

Picture what the country was, what all countries were, when land transportation was by the pack trail. Even poor roads was a great advance, then better roads, then artificial water ways. What a part the Erie canal played in the development of the great West! Probably no other public work of any State of the nation has been so rich in results. Settlements extended west, because they could send their farm products east. The first miller to send flour from Ohio to New York died but a few years ago, and he has left a graphic story of the trip he took. Then came the railroads, as the great land highways, and their spread has been the great economic feature of the age; they have changed entirely the aspect of Connecticut farming, but Connecticut country roads are to-day essentially in the condition they were before the days of railroads, before the days of telegraphs and telephones, and a thousand and one of these modern "implements of progress."

But it has been essentially the railroads that have made a common market for the farm products of the North Temperate Zone. Yes, wider than that, — railroads in tropical India, even, affect the price of American farm productions, — and a railroad has just been finished across the Arctic circle, which will probably somewhat affect other Connecticut commodities; and yet our roads are what they were when we had to grow our own wheat and carry it to our local mills to be ground.

The precise way in which farm products have been affected by railroads has not always been what was anticipated. It has affected grain more and horses less. When I was a small lad the first railroad was built across New York State. Forty miles from us it passed through an important "staging" center. The farmers feared that their market for oats and horses would be spoiled. There were 2,200 stage horses kept in that one village; the railroad would destroy staging, and with it the horse market.

As a matter of fact, the markets were better, and more horses are required with the railroads than without. That has been the experience of many places. I have seen statements to this effect in this State and in Pennsylvania, as well as in New York, where farming regions have been pierced by railways after being densely settled up. The fact is, the railroads bring business for the farmer of kinds that require more horses and better roads. Just as the railroads have helped develop faster roadsters, so, too, they foster business that requires more horses.

The railroads have so profoundly affected farming, so many have been injured by the change, or think they have, and the corporations have so often been oppressive and unjust, that the farmers have tried to right matters. They have struck out wildly and blindly, as the masses so often do when trying to right a great and wide-spread wrong. Much of the railroad legislation has been evil rather than good; in this we are feeling our way, and I need not expand on the subject because of the sound address we had this afternoon from that master of the subject, Professor Hadley.

I wish to say, however, that I do believe in the legal control and restriction of railroads. They consider themselves private property because built with private capital as an investment. But they have public functions and have public duties. There are various kinds of private property which a man cannot use as he pleases; what is for the public good has to be regarded. When most of the flour and meal of the country was ground at local custom mills, although strictly private property, the miller could not grind any one's grist as he pleased. They were subject to laws for the good of community from the earliest days of the colonies. In a similar way, I have no doubt whatever but that a certain control should be exerted by law over railroads which is not extended to all or even common private property.

They usually hold franchises of value, and this creates and imposes duties to the public. Franchises have a money value; if you have any doubts on that point attend a few sessions of the General Assembly and watch the efforts and lobbyings to obtain them. I will not expand on this farther than to say that I do not believe that one-half that are sought are asked for with the *bona fide* intention of the parties to do what the franchises are asked for to do. Gas franchises, parallel roads, steam-heating companies, horse railroads, etc., I have in my mind examples of each, which were asked for not to build but to *sell.* I cite these merely to show that a railroad franchise has a money value which has been given by the people's representatives, and in which the only return is that the public good is to be advanced. And I feel that railroads have public duties as truly as if they were built with the public money and run by government officials.

Railroads more and more dominate our affairs. If allowed to do as they please they can make or break any man in trade along the line, and in many places they have complete power over the farmer. In the work I did for the government at the last census, in investigating grain production, I saw many cases in the far West where the crops of one man were carried at one price and the crops of his neighbor at another price, "special rates," were made dreadfully elastic, and in some places "special rates" meant special favors to friends, or possibly special punishment to enemies.

We must have laws on the matter. While railroads have been and are a great and beneficent help to the race, they are run and managed by men that are but human, and need watching and restraint.

There is one matter in which I believe they may be of use to the farmer, or rather may ultimately increase agricultural production. Of late, they have been building up the cities, and this has been somewhat at the expense of the country. I trust that a reaction may set in, and by some form of cheaper commutation rates, again bring back men to live in the country, where they may cultivate a garden, or at least be nearer the source of healthy supply. Of late years, they have been indirectly aiding in making more dreadful the tenement-house problem in the great cities; I hope for a change, when they will aid in bringing their miserable occupants back to the country again

But I wish to leave the subject by the same way that I entered it, the common road, the country road. Keep these before your mind. Do not be so dazzled by the greatness of railroad traffic, and the changes it has wrought in farming, as to forget that all farmers who travel by rail, and all farm produce that is carried by rail, must first be carried over country roads to reach the rail, and again be distributed by animal power and wagon when it leaves the rail. With every advance of railroads, country roads become of more importance.

Mr. OLCOTT. I do not know whether Prof. Brewer will let me put a patch on the lecture or not.

Prof. BREWER. Yes, sir. Patches on the seat of learning are always in order. (Laughter and applause.)

Mr. OLCOTT. Prof. Brewer said in the course of his lecture that we could not haul heavy loads much more than twenty miles over country roads, and that is very true; I do not think there is much heavy stuff brought to Hartford from a distance of over twenty miles. But I want to say a good word for Boston; I don't often do it. In 1867 or '68, I went to Concord, Mass., which is about twenty miles from Boston. It was Saturday night. Well, Monday morning something or other disturbed me. It was not the noise of boys or anything like that, but a constant rumbling. Thinks I "What does that mean?" I did not want to get up a bit, but I did, and went to the window, and there, in the gray of the morning, as far as I could see, I could spy one-horse teams loaded with vegetables for the city of Boston, the horses and drivers all apparently having a good time.

Senator **Kirkham.** There was another little rent in the Professor's lecture that I want to close up. I judged from Prof. Brewer's paper that the roads around New Haven are not very good until they get upon the paved streets of the city. There they are good, of course.

Prof. **Brewer.** Only some of them.

Senator **Kirkham.** Around Hartford, and even in the city of Hartford, the roads are very poor indeed. After we leave the roads of the town I live in, we strike a very poor road in the city of Hartford. We have petitioned and remonstrated with the road commissioners of Hartford, for the last six months, and four weeks ago they sent out a man with a crowbar, who removed some of the biggest rocks in a strip of a mile, and left the road in that condition. That is not in a country town, it is in the city of Hartford.

Mr. **Hubbard.** In the discussion of the road question which we have heard here to-day, a good deal has been said in regard to the proper method of constructing and repairing roads, but very little in regard to one point which was touched upon by Prof. Brewer; that is, the proper use of roads and the proper regulation by law of the use of roads. I think he mentioned in one place the lack of any restriction in regard to chaining wheels. If I am not in error we have upon the Connecticut statute book a law providing that no person shall chain a wheel going down a hill unless it is drawn upon a shoe not less than six inches in width. I have the impression that legislation on this matter might very well go a little further and prescribe something in regard to the width of tires used in hauling heavy loads over the roads, and my mind has been drawn to it from the fact that I have one wagon the wheels of which have tires three inches wide, and the advantages which I have seen in my use of it convinces me that if everybody else had wagons like mine the roads would be a great deal better and our wagons would run a great deal easier. I believe that if no one was permitted to carry a heavy load unless the tires of his wheels were at least three inches wide, our roads would be kept in better condition. I believe that is a proper subject for legislation, and that such a law would have a very beneficial effect upon our country roads.

Now I want to illustrate one point in Prof. Brewer's lecture, and that is the extraordinary cost of moving farm products long distance by wagons. Under some circumstances it is an absolute necessity to do it, regardless of cost. Some twenty-two years ago, it was my fortune, while in the military service of the government, to be stationed with a company of cavalry under my command 700 miles west of the Missouri River for three months, and when a contractor delivered to us some grain to feed our horses I had the curiosity to gather the facts from him from which to figure out the cost of that grain, and I found that the grain with which we fed our horses cost the United States government between $16 and $17 per bushel. I think that is the most expensive feed that I ever gave an animal that carried me. The cost, as you may imagine, of maintaining a cavalry regiment out on the plains was almost fearful, and fully justified, I think, the aid that the government gave the railroads.

Prof. **Brewer.** In that connection let me say that sometimes freighting may be done in a new country comparatively cheaply. Take a country like the plains: There was an enormous amount of freighting that went over the plains, but considering what it would cost in a country town in New England, it went a great deal cheaper than you would think it could. No roads had been built and the freighting was done by oxen, and they would take their own feed on the way. Time was no object. It used to take three months to go from St. Joe to California. It was an expensive operation, but relatively no such expense as it is to the ordinary farmer to carry his produce over the roads of Connecticut.

Sec. **Gold.** I would remark here that one of the largest iron companies in the State, doing a large amount of teaming, have changed their tires on all their wagons to three inches wide, with a very manifest improvement of the roads over which they traverse.

Mr. OLCOTT. What were they before, pray?

Sec. GOLD. They ran from an inch and a half to two inches, and they would be used until they were worn to an edge. Our old coal wagons were run until the tire had a perfect edge to it. One word more: In laying the keystone of the arch of the Hoosac tunnel there was a very large stone to be transported over a piece of soft ground. The vehicle that was employed to transport it was two rock-pullers put together. The tire is about ten inches wide and the wheels are some eight feet or more in diameter. Two of those were put together and a stone that weighed ten or fifteen tons (I forget the weight exactly) was drawn with perfect ease and safety over comparatively soft ground, where common vehicles carrying only a ton cut through and the teams were stalled. Those wheels scarcely indented the soil, the breadth of the tires and the size of the wheels furnishing so large a bearing. It was a triumphant exhibition of the advantages of broad tires and large wheels for heavy burdens.

Mr. OLCOTT. I want to say one word about the breadth of tires. In some parts of Germany, before the advent of railroads, it was obligatory that heavy freight should go on tires twelve inches wide. At one time I was running three ox-carts in Rhode Island with tires eight inches wide. It was rather a new experience to me, but I was well satisfied with the result. I could drive those carts anywhere without making a rut. In Manchester, my native town, we have, I presume, twenty such carts. It is well understood there that nothing less than six inches can take a heavy load over the roads. A friend of mine has a one-horse cart that he is very proud of, the tires of which are six inches wide. I think myself that five inches is narrow enough for a one-horse cart, and that six inches is narrow enough for a two-horse cart or an ox-cart for farm work.

Mr. **Augur.** There is a single point that I was thinking about to-day after Mr. Olcott's paper, to which I would like to allude, and that is the matter of changing the grades of some of our roads. It is well known that in quite a number of localities in Connecticut efforts have been made within the last few years to reduce the grades of the roads, and with very great benefit. In our own town there are at least four or five instances of this sort. In one case about a thousand dollars was expended on half a mile in grading a road where the hill had been very steep, and after the work was completed, the remark was made in several instances, "Why was not this done before, that we might have had the benefit of it years ago?" Why can there not be more of this? In some of the farming towns, let the people take one hill at a time and grade it, and in a few years the character of the roads through the town will be essentially changed. Between the place where I live and the city of Meriden, where it used to take us an hour to traverse the four miles, we can now go easily in from thirty to forty minutes, with even a larger load.

The quartette then sang another song, which was heartily applauded.

The **Chairman.** The subject of the lecture to which your attention is now called is "Farm Life in Connecticut, Past, Present, and Future." I have the pleasure of presenting Mr. R. S. Hinman, Assistant Secretary of State.

## CONNECTICUT FARM LIFE. PAST, PRESENT, AND FUTURE.

### By R. S. Hinman.

In considering Connecticut farm life in the past I do not propose to take you back to the time when our ancestors led pioneer lives; as we, who propose to stay on the farms cleared of the forests by our fathers, can learn little from such consideration. We often hear of a time in the past when Connecticut's foremost citizens were farmers, and when the principal occupation of her people was agriculture, and the passing away of this time is sometimes bewailed by the farmers of to-day.

If we go back to the time our present State constitution was adopted in 1818, a little less than the three score and ten years allotted to man, we find that the State had a population of about two hundred and seventy thousand, and there were fifty thousand persons engaged in agriculture: nearly three times the number engaged in all other avocations. Settlements were made in the colony nearly two hundred years before and there were undoubtedly more acres of land under cultivation then than now, and about six thousand more persons engaged in agriculture.

For farm life in the past we need not go back of this date in our search for blessings that are departed.

The farmer of that day certainly escaped some of the perplexities that beset us.

His wife never suggested that the old ingrain carpet on the best room ought to be supplanted by brussels; for the best room, like all the rest, was carpetless, except in case of very thrifty people, when a home-made rag carpet, or more rarely still, one made of wool and tow covered the floor. The young farmer was not troubled to decide whether a side-bar or end spring buggy should be bought to take his wife to church in, nor whether an organ or piano should have a place in the sitting-room.

These were not matters of current interest. The farmer with boys growing up about him was not called on to worry much about what business John or Henry should be fitted for. When those embryo citizens were not sitting on the flat side of a slab in the school-house learning to read and write and the mysteries of the four ground rules, rule of three, and barter, they were helping their father on the farm. That rule of barter that I just mentioned was an important one in the arithmetics of those times, for money was not over plenty. Farm produce went abroad for a market and the grower "bartered" it for rum, molasses, minor groceries, and wearing apparel, and paid his help in provisions, wool, flax, and home-made cloth, or in orders on the store-keeper. Where, as was apt to be the case, there were more girls in a family than were needed to assist in the house-work, some of them hired out in neighboring households, and I have heard a lady now living tell of working for one yard of woolen or two yards of linen cloth, just from the loom and unfinished, valued at fifty cents, for a week; and for this she was expected to do house-work, milk, and fill in spare time spinning and weaving. In eight years that she so worked she never but once received any money, and then but ten dollars, in payment of her wages.

The farmer did not "wait for Barnum" to take the children to see the animals in those days. There was neither time nor money to be wasted in that way even if conscientious scruples had not prevented.

Religion partook largely of an abiding faith that he that endured unto the end, should enter an eternity of rest. The principal pleasure derived from it in this world seems to have been from such contemplation as that of the pious Scotchman who thought,

> ——" the prayers and holy chaunts
> And all the self-denial of us saunts,"
> Should ——" be repaid by the delight
> Of hearing, from that region black as night,
> The yelling, gnashing, and despairing cry,
> Of wretches that in fire and brimstane lie."

Butcher carts did not supply fresh meats the year round, but enough pork and beef was salted in the fall to last until butchering time with its abundance of fresh came again.

Books and newspapers were rare. I question whether the present abundance of reading matter has not tended to lessen the sociability that existed among farmers in the olden times. The amusements of those days were mostly derived from neighborly intercourse, sometimes through evening calls, when over a pitcher of cider, a pan of apples, and another of nuts, if it be in the fall or winter, jokes were cracked with the nuts and stories retold that were veritable chestnuts ; and again, the men gathered at the store or blacksmith shop, partly for business but largely for gossip and pastime. The young people — the unregenerate — danced, and the very bad played cards. They also derived much amusement from tricks played on each other or their elders, some of which would hardly be considered allowable now.

Theological questions were discussed with as much ardor as political matters are now in a presidential year.

I remember hearing, in my youthful days, a grave member of the then prevailing church tell of the discomfiture of a member of a new church just then coming into prominence.

Brother Burch, of the new church, did not believe in the doctrine of saints' perseverance, and stoutly maintained on all occasions that a Christian might, if sorely tempted, fall from grace.

He also prided himself upon his skill in "doing sums" however puzzling they might be.

In the neighborhood there lived a fat old wag usually designated Squire John. One day brother Burch was at the blacksmith shop boasting of his mathematical powers, when an irreverent bystander interrupted to say that he heard Squire John give a hard sum the other day. Brother Burch at once took out his plummet, found a smooth board and asked what it was. Squire John said "if brother Burch should fall from grace how far would he have to drop?" Brother Burch dropped his board and started off to find Squire John and learn whether he had actually propounded so derogatory a question.

With a people practicing such rigid economy as our forefathers did, we might suppose that Connecticut was at this time rapidly accumulating wealth; but we find little evidence of such being the case. The number of persons engaged in avocations other than farming gradually but slowly increased and the value of dwelling houses increased from nineteen millions and some odd thousands in 1818 to about thirty millions in 1845, but during the same period the value of all the land in the State had decreased from nearly fifty-three millions to a little over forty-nine millions, and the scarcity of money is evidence that gold was not rapidly accumulating in the hands of the farmers. The West was being settled, communication opened, and the products of new and fertile soils competed with those of the fast depreciating farms of Connecticut in the export markets. Young men, and, indeed, whole families were leaving the farms on which they were born, not to dwell in some near manufacturing town, for there was nothing to keep them within the boundaries of Connecticut, but to the then far West, to settle New Connecticut, as a portion of Ohio was long called.

And, my fellow farmers, this was in the halcyon days of the past; when the spinning-wheel stood by every hearth-stone and its hum made the music — aye the only music — of the household; when no clouds of factory smoke hung over our valleys; no factory waste polluted our streams, and no factory dams checked their free course to the sea.

The word "malaria" was unknown. They told pitiful stories, however, about a disease which they called "fever and ague," that was very prevalent a century ago. My grandmother used to tell of having thirty-two "ague fits" alternate days for two months, when living, as she did in her younger days, in the Housatonic valley. There was some uncertainty in my grandmother's time about the cause of this trouble, but she was confident it was due to eating water-melons. Time forbids my digressing to discuss this matter, but I recommend those who are searching for a cause for malaria in our day to follow up this clue; noting the coincidences that the disease is usually prevalent in the water-melon season, and rarely occurs on high cold land where this luscious fruit will not grow, for I verily believe there are theories as to the cause of malaria advanced now that are less tenable, if it be possible, than my grandmother's water-melon theory.

It is evident that whatever advantages the farmer of the past had, politically, socially, or in any way that tended to make him prosperous and happy, due to the fact that agriculture was the chief industry of the State, they could not as things were going, last. In raising exportable products he could not with profit compete with the West and the attempt must not only ruin him but his farm. Evidently a change must come or all must go West.

The change came. Just as Connecticut agriculture was at its lowest ebb, little dams began to be built along our rapid streams and the effect soon became apparent. The farming lands of the State as a whole no longer depreciated in value with each assessment. In 1860, about fifteen years after our farms reached their lowest valuation, we find the lands in the State to have increased in value nearly two and a half times what they lost during the preceding quarter of a century, or about ten millions of dollars, and the mills and stores, although worth but half as much in the aggregate as the farms, were assessed at ten times their value when our story commenced. This brings us to the beginning of the rebellion.

Then came our four years war with its attendant miseries, the like of which God grant none of us may ever see again. During its continuance and the years immediately succeeding, values were so inflated, that we cannot safely draw comparisons, but in 1875 we were sufficiently settled to take an account of stock and we find affairs in our little State wonderfully changed.

Before I give you the figures demonstrating this change allow me a few words in explanation.

Land, like bank stock, is valuable for what it produces. Stock in a bank may to-day be worth a hundred dollars or more per share, but if to morrow the president or cashier should rob the bank of all its available resources and skip to Canada, the man owning stock would have the same papers with the same figures on them, but they would be valueless. If the farmer robs his land of its available resources and leaves it, the acres remain, the deeds of conveyance are the same, but the value is gone. Thousands of acres of land in Connecticut have been so robbed and when we hear of the reduced value of farms, as we often do, a little investigation will show that this class of farms is made the standard.

But notwithstanding this unpatriotic and suicidal waste, we find that in 1875 the land in the State had increased in value nearly another ten millions; the dwelling-houses were more than four-fold their value in 1845, having increased from thirty millions to one hundred and thirty millions in thirty years, and the taxable value of the manufactories, mills, and stores had increased to sixty-four and one-half millions of dollars.

There is no single item of statistics that will measure the prosperity of a people more than the value of their dwellings. An intelligent, prosperous people were never yet domiciled in mud huts, and this increase of more than one hundred millions in the value of our dwellings in thirty years tells a wonderful story.

The number of persons engaged in farming, owing partly to the introduction of labor-saving machinery and partly to the fact that some of the poorer and rougher fields had been worn out or abandoned, was less than in 1818. Instead of there being but one-third as many persons engaged in the other avocations as in agriculture, there was more than three times as many or about one hundred and fifty thousand.

With the best markets in the world at their very doors, everything salable at prices that our fathers would have thought fabulous, is it any wonder that farmers made money? and with money coming so easily is it any wonder that they learned to spend it?

There is many a school girl to day whose wardrobe contains more and finer clothes than would have been thought necessary for a wedding outfit when most of us were children. It is not necessary for me to tell you how the farmer in the present lives; there can be no doubt as to its being an easier and pleasanter life than that of his predecessor. The changes however have not all been for the better. Many things, that if they were thought of at all by our fathers, were considered as unneeded or unattainable luxuries, are looked upon as necessities by us ; hence we find our ordinary expenses much increased. Economical management and business capacity are not out of place on a farm to-day.

With the advent of the pleasure wagon, the pillion went out of use, and the saddle, especially the side-saddle, followed. In the prosperous times that ensued, only the very poor were obliged to walk and it became exceedingly unfashionable, especially in the country, when everybody of means kept a horse, for ladies to walk at all. To this we may in part, if not largely, attribute a lack of physical strength and development.

"Buxom country lassies" might not have been a misnomer years ago, but of late years, the town-bred girl has taken vastly more out door exercise, especially after she considered herself a young lady, than her country cousin, and it is a question whether we should not say buxom city lassies in these days. Allow me to quote from an article in a daily paper which I lately came across. "Two old fellows loafing in a club window the other day were discussing with some warmth the evolution of the New York girl. They agreed that she had increased in both stature and girth since the days when they were young. One of the old gentlemen declared that the introduction of athletics for women had added two inches at least to their stature, and that women with waists under twenty-four inches were uncommon, whereas when he was a young fellow anything over twenty was considered vulgar, and they often succeeded in lacing them down to fifteen. 'And by Jove!' said the other, 'we encouraged that hideous practice by admiring it, sir. I blush when I remember it and look at my daughter, if I do say it myself, as fine a young woman as you'd find in a month of Sundays. Five feet seven to a hair ; twenty-six inches around the waist and thirty-eight around the chest and bust. Cheeks like a peach and can jump fences, swim like a fish, walk ten miles or play tennis all day. Gad, sir, she's glorious, and her mother, who had a seventeen-inch waist when I married her, is dead, after being on a sofa ten years.' They came to the conclusion that as a whole the New York girl of to-day was, as a physical specimen, vastly her mother's superior."

Vassar girls are said not to mind a walk of half a dozen miles of an afternoon as a constitutional, and a friend of mine tells of taking an eight mile walk out from Boston with a graduate of this institution, rather than decline her somewhat bantering invitation.

I can point you to town bred ladies, mothers of families, who boast of their ability to walk six miles straight away on a country road, without feeling uncomfortably tired. Can you find farmers wives willing to acknowledge themselves able to do such a thing?

I am aware that this is not flattering, my friends, but I believe in the old adage, "never spoil a story for relations' sake," and there is too much sad truth in the statement that farmers' girls have, in years past and still do, lack physical culture. A glance at the statistics showing the number of children between the ages of four and sixteen, in proportion to the population, in our cities, and in some of the purely agricultural towns is not without its lesson.

The future of Connecticut agriculture is of course somewhat problematical, but there is nothing now to indicate that the farmers may not be prosperous in years to come. But one thing can prevent it, and that is the destruction of our home market. This can be done in two ways ; by paralyzing the industries of the State other than farming or by reducing the wages of persons engaged in these industries so low that they can only buy the necessaries of life. Perhaps some of you remember the remarks by Mr. Hawley of Fairfield County, at Norwich two years ago, upon the subject of sending apples to England. He said in effect that there was no market in England for any apples not fit to go on a gentleman's table ; the working classes could not buy apples at any price. Connecticut farms can never again grow exportable productions and we shall have hard work to live if the time ever comes when our mechanics and laborers receive only such pay for their labor as will enable them to buy breadstuffs and other staples, such as the West can supply.

There seems, however, to be no immediate prospect of such a condition of affairs. Our various industries are in a reasonably thriving condition and likely to remain so. We can and should put into our markets better butter, beef, and poultry ; fresher eggs, fruits, and vegetables, than our competitors can supply, and buyers should have the assurance of their own experience that they can patronize home industry and benefit themselves by getting better and more wholesome food at the same time. The farmer that mixes the dozen eggs he found in the woodpile, that "hadn't been set on long enough to hurt 'em," with a few dozen fresh ones may get a few cents at the time, but he does ten times the damage to himself and his brother farmers by creating distrust of the home product, and every pound of poor butter marketed from Connecticut farms is a damage not only to the maker but his neighbors. Bear it in mind, that the West can beat us in cheap goods every time.

Possibly some of our rougher lands may be turned into extensive pastures, owned by individuals or associated parties where sheep or cattle, properly cared for, may roam at will; and the shepherd with his dog become some day a familiar sight among our hills. Co-operation as in the creamery business may be introduced in other branches of farming in order that improved machinery and the best results may be obtained, and men of means and executive ability will continue to own and manage large farms, but the tendency of the times seems to be in the direction of small farms, each owner holding what he can care for himself.

"Happy the man
Whose only wish and care
A few paternal acres bound,
Content to breathe his native air
On his own ground."

The coming farmer in this way will not become a millionaire, as fortunes are not earned by a single pair of hands.

He who wishes to accumulate much wealth must employ many hands with a profit from each or he must speculate in railroad or other stocks, or engage in some other form of gambling. Of course the chances are thousands to one against him, but he will not stand any chance of earning a million dollars on a farm.

Ireland owes her present unstable condition, we are told, to the fact that the land is owned by a few very rich men, and we are told also, that France owes her prosperity to the fact that the land is owned by the peasantry that tills the soil. As individuals, we might rather be Irish landlords, with a score or a hundred tenants, than French peasants tilling our few acres, but, as patriotic citizens, interested in the future of the State, we might view the matter differently. If every man tilling the soil of Connecticut owned the land he tilled, neither Henry George nor the Anarchists would find missionary work among us profitable.

Such people would need to be frugal and industrious, but they would be independent, and. here in Connecticut, have greater facilities for enjoying themselves socially and intellectually than the farmers of any other section of the world that we know of outside of New England and portions of the Middle States.

If the farmer so situated is ambitious to leave the farm he tills in such condition, that the generation that comes after him can obtain as much sustenance from it as he can, he will find scope for his ambition and patriotism at the same time, and unless a man has some such ambition. some admiration for the beautiful hills and valleys among which, and some love for the soil upon which he was bred and reared, it is doubly a misfortune, a misfortune to the commonwealth and to himself, if circumstances compel him to live and die a Connecticut farmer.

Adjourned to Friday, at 9.30 A. M.

## THIRD DAY.

The Convention was called to order at 9.30 A. M., by Mr. Dennis Fenn of Milford, and the Question Box was again opened.

Secretary **GOLD**. "Is there any cure for tuberculosis?"

Mr. **CHEEVER**. I would like to say a word on that subject; not that I am going to tell you how to cure tuberculosis, but I am observing a little how things are working in regard to cattle diseases. I presume that Connecticut and Massachusetts are situated somewhat alike in this regard, and the subject has been discussed a good deal in our State, and some people are recommending that the Cattle Commissioners put tuberculosis on their list with pleuro-pneumonia as a disease that they should stamp out. The way it looks to me is this: Supposing your State or our State appropriated a million of dollars, more or less, to stamp out tuberculosis, and supposing that Cattle Commissioners with sufficient knowledge of veterinary science should go around and mark each animal that was diseased, or each herd that was diseased, so that there would be no doubt about it, and then, supposing that the State should pay for the killing of those animals or those herds, what good would it do, under the present system of replenishing our stock? We go to Brighton, we go to New York, and we buy what we find there, and bring home cattle to replace those that have been killed, without any safeguards being placed around them, without any care upon the farms to keep them healthy. We should be all the time buying the disease, and the State paying money to extirpate it. It seems to me it would be one of the most foolish expenditures that could be made — like trying to stop a freshet by putting in a dam at the lower end. Now, if we would save the calves which are being slaughtered ruthlessly, save our skim-milk that is now wasted to a greater or less extent, and raise our own stock on our milk and dairy farms, and, if we want to buy new stock to improve our herds, put the animals that we buy into quarantine on our own farms until we have kept them long enough to know that it is safe to put them into our herds, then it would do to talk about extirpating the disease at the expense of the State; but while we are taking stock upon our farms without any discrimination whatever tuberculosis cannot be stamped out by the State with profit.

Mr. **Hyde**. I desire to say but a single word, and that is to endorse most thoroughly what has been very justly said by Mr. Cheever, one of the Cattle Commissioners of Massachusetts. I fully concur with him in his declarations in regard to this disease. If the Cattle Commissioners of this State or of Massachusetts should attempt to treat tuberculosis as they do pleuro-pneumonia, that is, wipe it out, one thing is very certian, that the Cattle Commissioners of New England would be wiped out. It is a disease that is increasing, and I think the only way to rid ourselves of it is to carry out the suggestion that has been made by Mr. Cheever.

Secretary **Gold**. "How shall we best manage the quince?"

Mr. **Augur**. I will just touch on one or two points. I believe that the quince is a neglected fruit generally, and in my travels about the State I do not recollect to have seen more than half a dozen good quince orchards, if I have that number. It seems to me that it is a question that people should think about. The quince is one of our best fruits for preserving and canning, and I often wonder that people do not supply themselves with a larger quantity of it for home use. In the first place, we should get a good stock of either the apple or orange quince or the champion; the only objection to the champion is that it is a little late; still, it keeps into winter, and with good culture grows to large size. I would advise, in the first place, selecting a deep, rich soil, not too wet; if it is wet, it should be underdrained. When once planted prune carefully and judiciously with a pruning-knife, so as not to have too many large branches. Be particularly careful to keep the borers out! I think the quince is a fruit which is more seriously affected by the borer than any other; at least, that has been my observation. In regard to fertilizers and cultivation, I think a mistake is sometimes made by those who try to do their best in getting too deep culture. The quince is very often seriously injured by the plow. The roots of the quince lie near the surface invariably, and the use of the plow among quince trees does very great damage. Mr. C. L. Jones of Newark had some quince trees that came nearest perfection of any I have ever seen, and I will just give you his method, for I think it is worthy of imitation. In the autumn or early winter he spreads around his trees, which have been carefully pruned and looked after for years, a covering of two inches of fine stable manure, and in early spring, instead of allowing a plow to go near them, or even a spade, he uses a fork, and mixes that manure well with the earth. Of course there is abundant material for securing a good growth and a good crop of fruit. I believe he has sold his quinces at six dollars a hundred by count. When people ask him what variety of quince he has, he says the orange quince. Many people hardly believe it, but at all events his fruit is very beautiful, very large, and very excellent. Year after year he repeats this process of high culture, and gets most satisfactory results. I think if we should give better culture, better manuring, and use more caution to keep the borer from destroying the trees, we should feel abundantly satisfied with the results.

Question. How shall we get rid of the borer?

Mr. Augur. The trees should be carefully inspected at least twice a year, and if any borers are discovered they can be removed with a sharp-pointed knife. Then you may apply whale oil soap about the collar of the tree. Or, if you desire, you can make a mixture of soft soap and water, of the proper consistency, to be used with an ordinary whitewash brush, which can then be easily applied to the trunk of the tree. If you do that in time to prevent the deposit of the egg by the beetle, you will find it effectual. If the borer is already in the tree, I would not have it understood that that is going to cure it, because the worm is then sheltered by the bark of the tree, and the mixture may not reach it. Soap is offensive to the insect, but if you have the borer in the tree the only way is to find him and destroy him, and then by an application of some soapy mixture, I think you can be reasonably sure of keeping clear of the borer.

Mr. Platt. I would inquire if that manuring is to be repeated?

Mr. Augur. Yes, sir, annually.

Secretary Gold. It is as a mulch largely that that manure acts, in protecting the roots from the severe action of changes during the winter, and hence an annual application of some mulch, as well as fertilizer, seems to be required to preserve the life and health of the quince here in Connecticut.

Mr. Olcott. I wanted Mr. Augur to tell us whether the orchard in New Jersey was pruned in tree form, how broadly the manure was spread, and also what the soil was.

Mr. Augur. It can hardly be called an orchard. The trees occupy the rear end of a city garden. The soil, so far as I could observe, is a deep, strong loam.

Mr. Olcott. Clayey?

Mr. Augur. Clayey. The form of the tree I will touch upon. It was a low-headed tree which, if a person were to go under it, he would have to go upon his hands and knees.

Mr. OLCOTT. One stem?

Mr. AUGUR. A short stem, I should say. I think some of the trees might have had two or three stems, and some of them, I think, only one.

Mr. OLCOTT. He spreads the manure how broad?

Mr. AUGUR. As far as the branches extend, and a little further.

Secretary GOLD. "What kind of potato is best for a late crop?" Mr. Platt must tell us.

Mr. PLATT. I think that is a pretty difficult question to answer. It depends on the soil. I should not attempt to give a list for soil I do not know. The White Star is very popular in market; my choice would be the White Flower in the place of it. The Home Comfort is a very desirable potato, and the Snowflake, on certain soils, is the best potato we can grow.

QUESTION. What are those soils for the Snowflake?

Mr. PLATT. I do not know exactly. I have never made a success of it myself.

Secretary GOLD. How is the White Elephant?

Mr. PLATT. The White Elephant is not sure; it is very much inclined to rot. It is simply a late Beauty of Hebron under another name.

Secretary GOLD. Mr. Edwin Hoyt has had some experience with the White Elephant. Has it gone back on you, Mr. Hoyt?

Mr. EDWIN HOYT. We do not grow it now. Burbank's Seedling is the best potato on our soil for a late potato.

Mr. HUBBARD. I should second Mr. Hoyt's suggestion. Burbank's Seedling is really the most reliable variety for a late crop. I wish its quality was a little better.

Professor CHAMBERLAIN. I feel like saying that the first remark that Mr. Platt made is the secret of the whole question. It depends upon the soil. I think that has been fully demonstrated in the experience of many Connecticut farmers with reference to several varieties. It has been proposed that the Experiment Station should become the testing place of the various varieties of vegetables grown, in order that we may know just what to select from the great variety of seeds found in the market, but the difficulty is just here: The variety of potato that will grow in sandy soil, such as they have at the Connecticut Experiment Station in New Haven, will not succeed at all on the soil which I have to cultivate, and any conclusion that they may come to may be utterly worthless, and may be misleading to the majority of farmers in Connecticut. I think it is a matter that every man must study upon his own land, and find out for himself what is the best variety of potato on his ground, and that no man in this room can tell me what I should plant. I must settle that question for myself by actual test. Take, for instance, a very popular potato, the Early Essex, which is grown with the most remarkable success upon the soil of East Hartford. I have tried that potato, and I do not find it such a valuable variety for me. I think my friend Mr. Platt has tried it upon his soil with the same result. I know that we expose ourselves to severe criticism by anything like a condemnation of the Early Essex potato, and therefore I do not condemn it; but for certain localities I do not think it a profitable or valuable variety; in certain other localities it may be the very best potato that can be grown. I remember that some fifteen years ago I tried the Bliss Triumph on the soil that I was then handling in Meriden, upon the State Farm, and the result was a complete and total failure, and I abandoned that potato after two or three trials. I took it up into Tolland County, and on the soil that I am cultivating there I can grow it with the most wonderful success. The same is true with reference to other varieties. But if you pin me down to a single variety, so far as my experience goes, I say the White Flower is the best potato grown to-day. It has all the qualities of excellence in the potato. It has the quality of productiveness, of beauty, of perfection of form, and ripens between the earliest and latest varieties, growing sufficiently long in the season to perfect itself with moderate cultivation. Let me suggest that right here is where many of us make our grand mistake in the cultivation of early varieties of potatoes. We do not take into account the well-established fact that a potato growing in a very short time must have a much higher cultivation than a potato growing through a long season. To diverge a little, I take it that the reason why the tobacco crop must be cultivated with such an excessive amount of fertilization is the very short season of its growth; not that it exhausts the soil of the fertilizers that we use to any greater extent than an ordinary crop of corn. And so with the potato. If we cultivate an early variety of potato we must cultivate it with just about that amount of fertilizer that is proportioned to the time that it is growing. I was impressed with this fact particularly last year, growing, as I did, something more than a hundred varieties side by side, with the same cultivation. My early potatoes matured at a very moderate size; my late potatoes were very large and fine. Now, I lay it down as a principle of agriculture, that our early crops require more cultivation than our later crops. I think we often make a mistake right at that point. I have distributed the White Flower to a small extent in my locality this season, and in every instance have been assured that where other varieties have been grown with it, and the greatest pains taken to secure the best potatoes, that has been the best.

QUESTION. Would you recommend that variety on rather heavy soil?

Professor CHAMBERLAIN. I would. I think it is the potato that endures the extremes of soil remarkably well. I think Mr. Platt will bear me out in that, as he has cultivated it longer than I have.

Mr. DAY. Professor Chamberlain has taken the wind all out of my sails; he has anticipated me completely. I presume that Mr. Chamberlain, like myself, has not come here to advertise anybody's wares, but I must endorse emphatically what he has said about the White Flower, as decidedly one of the best potatoes grown. I have had some experience with the Bliss Triumph, and it has been at most times a complete failure. In illustration of what has been said with reference to the influence of soil, I will state that I have sent some varieties of potatoes that were comparatively worthless with me to friends living west of the Connecticut River, and there they were splendid table potatoes.

Mr. LATHROP. I must say that I raised the poorest potatoes this year I ever had in my life, and I am here to get information on that subject.

Secretary GOLD. There seems to be something else the matter besides the adaptation of a particular variety of the potato to the soil. I confess my inability to deal with that question. In connection with my brother farmers I have recognized the White Elephant as the coming late potato, and thought that it was going to be in demand everywhere. I raised it with the most flattering success for two years, but this year, although it has not rotted, it has failed to yield as well as the Early Rose, so that I cannot speak so decidedly in favor of the White Elephant. So of other varieties. It is not altogether the soil, but the other attending circumstances that we fail to understand, by which we either get a crop or fail to get a crop of potatoes in this State. It is certainly important to have a good variety, but in addition to that there are certain other conditions of weather and temperature that are beyond our control.

Mr. CHEEVER. I have been aching to tell what I know about potatoes, especially late ones, and the best late potato that I know of is the one that will ripen earliest in the season and give the biggest crop. I do not like to give much attention to a potato that the potato-bug will work on all summer long, and which comes to maturity about the time that the rot comes in. We do not get the rot in the early part of the season, and if we have the potato-bug to fight we can do it a great deal easier in two months than we can in four. I would recommend, therefore, giving our attention to getting a good crop of an early variety. The drouths may, as they do some years, spoil our early crop, but taking the average of years, with an early variety like the Rose or Beauty of Hebron, and a number of others that are closely related, it is possible to get a very satisfactory crop, on the average, from these early varieties, if we plant them early, and, as Professor Chamberlain, I think, said, manure them heavily enough with suitable fertilizers. When you get your crop put it into a dark, cold cellar, if you have such, or into a silo, and let the late potatoes be raised by your neighbors.

Mr. **Hubbard.** Will somebody tell us if there is any variety of potato, early or late, that is better in quality than the Early Rose?

Mr. **Cheever.** People differ about that, but the Early Rose, judged by the Boston market price, is the standard potato. It seems like the Concord grape and the Baldwin apple.

Mr. **Augur.** I would like to ask Mr. Cheever what his experience has been with reference to flat culture?

Mr. **Cheever.** Theoretically, I believe in flat culture, and I would keep it so if I could; but I cannot very well help hilling up a little in practice. (Laughter.) I want to say one word, while I am on my feet, about the Early Rose. I will guarantee that there are as many as three, perhaps more, kinds of potatoes under different names in the market that are so nearly alike, in every particular, that they may all pass for Early Rose, and no human being can separate them in the heap.

Prof. **Chamberlain.** I dislike very much to disagree with my friend, Mr. Cheever; I think it is always pretty safe to agree with him; but, really, I did not think he was so strongly inclined to put all his eggs in one basket. He objects to late potatoes, and would plant nothing but the early varieties. Now, under our present climatic conditions, we sometimes find that our early potatoes fail, while our late potatoes may be an excellent crop. For myself, I would recommend every farmer who cultivates potatoes for the market or for his family to be sure and cultivate both the early and the late, in order that if the peculiar conditions which we had last spring should be repeated the coming year, we may not suffer by it to the extent of losing our entire crop.

Mr. **Stanley.** I have raised the Early Rose since 1875. I secured at that time what I considered a very valuable seed, and have planted them ever since. I plant medium-size potatoes, sorting them out in the field. I think that that accounts, in a great measure, for my potatoes keeping as well as they do. I plant them whole, six inches deep, and there is no deterioration of the crop, and they are just as good for eating in June as they are in October; and as long as they answer my purpose as well as they do, I shall use them instead of any other variety. Meantime, I have had the Hebron, I have had the Early Essex, and two or three other different kinds. I prefer the old Rose to any other kind that I have ever grown. (Applause.)

Mr. **Broadley.** Sometimes when digging my potatoes I have found, instead of regular-size tubers, a lot of small ones with protuberances covering them. Instead of one nice potato, I find a whole family of little ones. My neighbors have had the same experience. I want to know whether any one can tell me whether that is on account of the weather, a lack of fertility, or climatic changes.

Mr. **Stanley.** I want to say, in relation to the Early Rose, that I planted potatoes by the side of two other men who cut theirs into two eyes for each hill. There came a severe freeze, and there was no sign of their potatoes. Mine all started and came from the whole seed, and I got a full crop, while in the other two cases, on the same land, right side by side, they did not get a third of a crop.

Mr. **Platt.** How do you manure your potatoes?

Mr. **Stanley.** I generally put them on land where tobacco was grown the year before, and I give them very little manure. I never get any scab on any potatoes I raise. I do not like to use any large quantity of barn manure on them. I plant them on land which has been enriched before, and use very little fertilizers of any kind.

Sec'y **Gold.** In reply to the question in regard to the knobby character of potatoes, I will say that when the Early Rose was first introduced it was cultivated, in some cases, with very great care, and irrigated during the dry season. I saw at some of the exhibitions at that time two samples presented by the same man, raised from a small quantity of seed that he had procured, that showed in one case fine, evenly ripened, smooth samples, and in the other case the potatoes were covered with those protuberances or knobs. He said that those knobby ones had been raised by watering the potatoes in his garden. After a drouth came, and before the vines died, he undertook to keep them alive by watering, and the result had been the development of a second growth in those little knobs that we so often find upon potatoes. I attribute it to a change in the moisture after a drouth has somewhat ripened the potato.

One other question and I will close the box: "Will some one name a relief which will be instantaneous from the sting of a bee?" Some of our bee men here ought to be able to answer that.

Mr. PECK. Some ten years ago, this remedy was suggested: Take up a little earth, moisten it with saliva, and apply it instantly. I have tried it and found that I could go about my work in less than a minute.

Mr. AUGUR. We have always made an application of saleratus water.

Mr. ———. I have found the application of tomato leaves to afford instantaneous relief.

Mr. LARRABEE. I have a very simple remedy for a bee sting, which has answered my purpose; that is, moistening it with ear-wax. It is a remedy which I have always at hand.

Dr. CRESSY. One of the best applications for a bee sting is a drop of dilute hartshorn or ammonia.

Mr. HOYT. There was a gentleman in New Canaan who was very sensitive to bee stings. I have seen him when he would go into spasms when stung by a bee. That gentleman always carried a bottle of hartshorn in his pocket, which was said to give him instant relief.

Vice-president DAY here took the Chair, and the regular programme for the morning was entered upon, being the

## REPORTS OF DELEGATE VISITORS TO CONNECTICUT AGRICULTURAL FAIRS.

### BERLIN.

The second annual "Harvest Festival" of the Berlin Agricultural Society was held on the 5th day of October, and was one of the most enjoyable and profitable exhibitions that it has been my privilege to attend.

The people were out in goodly numbers, and seemed delighted in meeting old friends and acquaintances and seeing the rich treat so generously provided. The fruit, flowers, fancy work, vegetables, grain, etc., was in great profusion, and shown in Grange Hall and in the basement. It would be superfluous to attempt to discriminate where all was at its best.

The ridge of mountains extending through western Massachusetts and Connecticut to Long Island Sound, furnishes a soil where all varieties of fruit common to New England are grown in their highest perfection, and here I saw a collection of rare excellence and beauty. People of all vocations have learned the ennobling influence of fruit-culture, and few well-kept homes are without a supply for most of the season. For a town show, the exhibition of cattle, sheep, swine, poultry, etc., was fair, and a number in each department were well bred and valuable.

The morning was devoted to bicycle, foot, sack, and hurdle races. Young America was out in full force, and furnished innocent amusement for all. A noticeable and commendable feature was an entire absence, so far as I know, of *small* beer or *large* beer; such shows as a calf with two heads, the fat woman; or games of chance, where young people often take their first lessons in vice.

ALBERT DAY, *Delegate.*

GOV. HYDE. I am at a loss to know exactly what fairs I was called upon to visit. I believe one among the number was that at New Milford. It rained so incessantly that morning that I did not visit the fair, so that I am unable to make any report with reference to it. I think I was delegated to attend the Tolland County Fair. There is a little emblem of that fair (referring to a very handsome structure upon the stage). It would be a great advantage to all of you to make a minute examination of it. This fair was a successful one in every respect—

one of the best that the county has had. It was largely attended, and the Grange exhibition was most wonderful, surpassing any show I have ever seen anywhere, either here or out of the State. The stock show was good. Nearly all classes of stock were represented. I do not know that there were any Swiss cattle, but there were a few Shorthorns, a few Holsteins, and a very large number of Jerseys. The show was very large and very excellent. There was a very good show of Devons. I do not want to say too much about them, as I was the only exhibitor. I can say, in general terms, that the Society has never been in so prosperous a condition as at present. The Grange has done a great deal for the Society, and is likely to do a great deal more. They are active workers, and as a member of a town and county society I wish to express my gratitude to the Grand Master here for what he has done, and to our friend Mr. Lathrop, and many others who have taken so active a part in this movement.

Another fair which I attended was the Danbury Fair. There were two delegates, myself and Mr. Hoyt of New Canaan, who I believe will represent this Society more in detail. It takes at least two pretty good delegates to represent the Danbury Fair. I will only say that this fair is managed better than any fair that I know of in this State. It is more systematic in all its arrangements; it is managed for the purpose of making money; and it has been successful as no other fair has been. If I am not mistaken, the stock, which was worth at the commencement about twenty-five dollars a share, is worth to-day about seventy-five dollars. I don't know what the dividends have been; I suppose ten or twelve per cent. They have erected upon their grounds quite a number of buildings for the accommodation of cattle. They are open at the sides, but can be made close, and the cattle are as well provided for there as in the best barns in the State if there comes a storm or cold weather. The buildings are erected in a circle, and in the interior the animals are brought into a ring and there examined and inspected. I do not know of any show that has such accommodations as they have there. I think they have more system in regard to the proceeds of the Society than anywhere else. Every dollar is looked after. No man can get into that fair who does not pay. I think perhaps they go a little too far in that direction. It is a question whether they are quite as liberal in giving facilities to their visiting members as are some societies that are poorer. They are very particular about giving out too many dinner tickets. I suppose that may be one reason of their success. Many societies that are poorer have been pretty liberal and have almost ruined themselves by their generosity in this direction. I understand that 52,000 people visited this fair. I thought I saw anywhere from five to ten thousand people who were going up and down through the great avenues, and I do not believe they saw any of the exhibition, or cared to; they went to see the crowd of visitors.

### WOODBRIDGE AND BETHANY.

The exhibition was the poorest ever held by this Society, so that some thought it might be the last. About twenty-five yoke of oxen, and a part of these were from Oxford. The neat cattle were poor in quality and very few in numbers. In the tent, all departments were very short, and attendance the smallest I ever saw.

UNION AGRICULTURAL SOCIETY (HUNTINGTON, MONROE, AND TRUMBULL), Have put up a building at a cost of $600. Number of pairs of oxen, 75, some of which were very fine; number of neat stock, 100 entries, 40 per cent. of which were blooded, comprising Devons, Jerseys, and Holsteins. The space allotted to poultry filled, the best show in this department they ever had. In the building, all classes were well filled. They were obliged to put off the fair two weeks, yet it was a success in everything except attendance, which made the finances come short, being able to pay only their expenses, but no premiums.

### MADISON.

Number of oxen, 113 yoke; 100 entries of neat stock; 5 or 6 of mares with foal at foot; the same of swine; 50 coops of poultry, the largest exhibition at a local fair I ever saw. The display of fruits not large but very good, and the same may be said of vegetables. The domestic and fancy departments very full. The attendance was large, and I heard only one opinion expressed, which was that the fair was a success.

DENNIS FENN, *Delegate.*

Mr. BILL. I was delegated by the Board to visit the Stafford Fair, in connection with Mr. Barstow of Norwich. I was also a committee on stock. Mr. Barstow agreed to be present at this time and make a report upon that fair. Upon my arrival upon the ground, and prior to its being necessary for me to go upon that committee, I commenced viewing the exhibits. I first went into Horticultural Hall, where I found every foot of space occupied, and there was a splendid show of fruit, vegetables, butter, and cheese. There was one exhibitor, who is now upon the stand, who had over eighty exhibits of fruit, and there were many others almost as large. The butter and cheese were fine. From Horticultural Hall I passed into the Exhibition Hall, where the ladies had a grand display, which was well worth attending. Whenever I visited that building during the two days that I was there, it was one compact mass of human beings. Suffice it to say, the ladies did honor to themselves by their exhibits in that department. There was a fine exhibition by the Tolland Grange. How they can devote the amount of time necessary to get up such an exhibition I certainly cannot tell. That alone was worth a visit from any part of the State to see.

When I left that building and went upon the grounds, I saw a large number of people, and there was a great deal for them to see. There was one string team that came in from different towns, composed of from two to three hundred head of cattle. There were some among them that had better have been left at home, however. But it seemed to me that the majority of the cattle upon the ground were creditable, and from the town that Mr. Holman represents there came a string of the finest steers that I ever saw coming from any one town. They would have done honor, every one of them, to our State show.

Gov. HYDE. I want to say a word about working oxen. I am a little inclined to take issue with my friend Bill upon that point. Cattle came there as working cattle; came from the field and from their daily labors. Those cattle were a fair representation of what there was all through our county. It is said there are no working cattle. Now, in this place there were 240 yoke of working cattle, — exhibited as working cattle, not as show cattle. We paid a dollar a yoke for those cattle, doing in that respect just what the Danbury Society does. They pay a dollar a yoke to get cattle there. I hope that our societies generally will encourage exhibitions of working cattle at our fairs. I believe they should be encouraged as they have not been in New England of late years. I believe more cattle should be worked upon our hilly, hard soils. (Applause.)

### GUILFORD.

The annual town fair in Guilford was a decided success. Secret, good management. This town is a shore town in New Haven County, fifteen miles east of New Haven, and is well adapted to farming. The fair was held on the town green, where were exhibited many fine horses, working cattle, choice cows, sheep, swine, and poultry, all in fine condition. The horse trot was not there, but all premiums were duly paid. The dining arrangement in tents, under the management of the Ladies' Aid Society, and other kindred societies, was admirable. Music Hall afforded ample room for the music, fruit, flowers, grain, potatoes, and vegetables, dairy products, wool, art, and fancy work, cookery, and miscellaneous articles, — sufficient proof of the general thrift of this good old town.

### FAIRFIELD COUNTY.

This fair was held in Norwalk, and was good in most respects. The horses and horned cattle, sheep, swine, and poultry were there in goodly numbers. The show of fruit, both natural and in cans, was very choice. The easy manner of the officials in making strangers feel very much at home added much to the success of this fair. Acknowledgments are due to the managers of both these societies for hospitalities received by your delegate.

H. LARRABEE, *Delegate.*

Mr. HOLMAN. I was delegated by the State Board of Agriculture to attend the New London County Fair at Norwich, and the fair at Willimantic. I regret very much to say that I had a very limited amount of time. I spent only two or three hours upon the grounds at Norwich, but, upon entering, I found everything in good order; long rows of cattle-pens and sheds filled with the best of cattle which New London County can boast, the sheep-pens all well filled, and the poultry, the horses, and working oxen were all that could be desired. I saw in the short time that I was there enough to make me believe that the New London County Society was in a prosperous condition. The grounds looked bright and attractive, the crowd was large, and I saw no reason to doubt that the fair was a gratifying success.

The same statement applies to the Willimantic fair. I was there only a couple of hours, but I saw that everything was in good shape. They had a grand show of stock and a large number of working oxen and steers. I should think they devoted more attention to horses at that fair than to cattle,— more than I think they ought to, the premiums being small on everything except horses.

### BRISTOL PARK AGRICULTURAL SOCIETY.

The first annual fair of this society was held the last week in September, commencing the 26th, for a five days' meeting. I attended the 26th and 27th. The morning of the 28th a rain set in, which continued through the week, breaking up what might have been one of the most successful fairs of the State.

This is a joint stock company, organized this year, with a capital of ten thousand dollars, divided into shares of $25 each. The stockholders number 344.

The society have secured the fair grounds of the old Pequabuck Association, situated on the line of the N. Y. & N. E. Railway, about one mile from the Bristol station, have added nearly twenty acres, comprising several groves of natural forest trees, making it one of the prettiest fair grounds in the State.

They have a fine exhibition hall, with basement, and a commodious barn and stalls for horses. It is the intention in the future to have the thoroughbred stock on exhibition during the entire fair, but this year, owing to the cattle-sheds not being completed, they were shown only the first day. There were eighty yokes of working oxen and steers, most of them of superior quality. Thoroughbreds as follows: Jerseys, 68 head; Swiss, 25; Herefords, 15; Devons, 10; Holsteins, 9; Guernseys, 20. In the discipline class there were 7 entries, and in trials of strength 14. Fat cattle, 9 and 31 head of grades. The show of sheep was small, only 16 head. These, however, were good. Although good premiums were offered for swine, only two were on exhibition. The exhibition of horses and colts the second day was quite gratifying, divided as follows: Stallions, 10; brood mares and colts, 24; matched pairs, 7; single driving and saddle horses, 19. The trotting course has this season been thoroughly regraded, widened, and otherwise improved, and the grounds are well supplied with water from the Bristol waterworks.

The exhibition of fancy work in the hall was large and fine; four large double show-cases were filled with samples of every description, with any quantity of quilts, afghans, spreads, etc., hung on the sides and overhead.

The Whigville and Plainville Granges occupied the entire east end of the hall with highly creditable exhibits from the farm, garden, and household, tastefully arranged.

The show of fruit and vegetables in the basement was excellent. On one side a wide table 75 feet long was loaded with apples, pears, grapes, and other fruits; on the opposite side a table fairly groaned under the weight of squashes, pumpkins, potatoes, and samples of most every vegetable grown. At the end stood several varieties of potted plants, bouquets of cut flowers, also in baskets, making a beautiful display.

The poultry show was immense, I think the largest ever seen at an agricultural fair in this State, 235 pairs — not including 145 pairs of pigeons — completely filling a large tent.

In another tent there was a bench show of dogs, 42 in number, pronounced by those more competent to judge than myself a good show. One notable feature of this fair was the auction sale of live stock, mostly registered Jerseys, which took place the second day, as advertised in the Premium List. About 25 head changed hands at what seemed to be quite low figures. I commend the managers, and recommend to other fairs the admirable arrangement for showing trained, draught, and other cattle, having a plot of ground enclosed with a light picket fence for that purpose, large enough to contain those competing, and keeping the crowd at a respectable distance, thus giving all a fair chance to see the performance.

In closing, I extend my thanks to the officers for courtesies shown during my visit at the fair.

### WOLCOTT.

The sixth annual fair of this Society was held October 12th. Their grounds are situated on the main road leading from Waterbury to Wolcott, about one and a half miles from the latter place.

The morning opened bright after the rain, but grew cold and quite blustering before night. As I approached the grounds I said to myself, "Here must be held a purely agricultural fair; there being no race-course, there can be no proverbial 'agricultural horse-trot' of which we hear so much said in connection with our fairs." The first thing to attract my attention on entering the grounds were two long trains of oxen, attached to which were finely-decorated carts with flags and banners flying. The air seemed filled with music, furnished by the famous Wolcott Drum Band. Already many spectators and exhibitors who had preceded me were hastening hither and thither, presenting a very lively scene.

Two sides of the fair-ground are devoted to the exhibition of neat cattle tied to posts, among which I see the fine Holsteins of A. B. Pierpont, Jerseys of Thomas Fairclough, and many nearly thoroughbred Devons, owned by Manville Norton. I counted nearly 75 pairs of working oxen. The exhibition of trained steers, trials of strength to the boat, discipline shown in handling a loaded cart, all of which were well conducted, attracted the attention of an admiring crowd.

The tent was filled with a great variety of fruits, vegetables, and articles of domestic manufacture, and a little of everything usually seen at such a fair. The show of horses was rather small, although some very fine cattle competed for the prizes. There was a creditable showing of mowing-machines, horse-rakes, and other farming implements.

Surely these annual festivals of the farmers of Old Wolcott are worthy of encouragement, evidently doing much good in many ways; and it was pleasing to note the interest shown by the attendance of the people from the adjoining towns of Waterbury, Plymouth, Watertown, and Bristol.

The officers are courteous gentlemen, and make no false pretensions over their "little one-day fair," as they call it, but I assure you if representatives from some of our larger fairs would visit it they would find much to admire in way of management worthy of emulation.

WM. G. FRENCH, *Delegate.*

### FARMINGTON VALLEY.

A good fair is a school affording a great many object lessons; indeed, there is hardly a product in our State of which the best specimens do not find their way to the agricultural fairs. Farmers vie with each other in the yield, size, beauty, and quality of their grains, fruits, and vegetables.

The same is quite as true about farm animals. No one need go further than his nearest cattle-show to be convinced of this.

When I was a lad, a horse that would make four or four and one-half miles per hour was considered a very fair horse; now, double or treble that speed is often obtained without the use of the whip.

The laws of heredity and good breeding in every line of farm stock are vastly better understood and practiced than formerly. This has, in part at least, been effected by competition and comparison at Agricultural fairs.

The improvement in the breeds of poultry have been no less marked. What was made no note of in the agricultural census schedule until the census superintendent was petitioned by the Connecticut Board of Agriculture in 1879 to embrace poultry products in the census of 1880, revealed the fact that our poultry, supposed to be so small, run up into the millions in value. So all through the range of farm and garden productions, improvement has been the watch-word.

It fell to my lot to visit the fair at Collinsville. The society have most beautiful fair grounds, Cherry Park. The front, for a half a mile, has a beautiful line of large sugar maples, while in the central part is an unusually fine grove of pines. The whole is surrounded by wooded hills, so that the space enclosed seems about the only place in the region fitted by nature for an agricultural fair.

The building in the central part was filled, and more than filled, with an interesting exhibit. Rarely have we seen greater evidences of skill, originality, and good taste, than in the fancy-work by ladies, old and young, at that place. We could readily believe, from what we saw of the ladies and their work, that the people in that vicinity had homes in which they might feel pride and comfort.

The dairy display was excellent, especially so of the creameries represented. The entries in all departments of live stock were unusually good. There was a great variety of fruits, grain, and vegetables — some varieties of which have been rarely seen in our State. No one can go to such an exhibition, with eyes and ears open, and not be wiser from so doing.

### BRISTOL.

Many points mentioned above would apply with equal force to Bristol; no less variety; good taste from the hands of the ladies; very much more capacious buildings; still more enthusiasm; and with auspicious weather, success seemed assured, but unfavorable weather always puts a check on attendance, as it did in this instance.

Rarely, if ever, has there been a more systematic arrangement of fruit than was made here ; thanks to the superintendent and management the plan in the lower hall was complete. Two Granges made exhibits here which can hardly be over-praised. The officers of this society evidently did all that could reasonably be done for a grand success, and so far as the exhibit was concerned, it surely was so in every line.

### SUFFIELD.

On the appointed day I went, only to find a postponement of which I was not apprised, so I saw a beautiful town, one of the best, with fertile farms and green fields, but missed the cattle-show.

### STAFFORD.

Nearly every hour in the day there is some attraction for the crowd. The hall for miscellaneous exhibits and fancy-work was full and interesting, so of the hall for fruits and vegetables, also the show of cattle, sheep, swine, dogs, and poultry.

And here, as in all other fairs, the greatest and most interesting show is the collection of people themselves, representing so many happy and interesting homes; so much intelligence, thrift; so much versatility of talent; so much sociability; and so much good will.

These fairs offered a gala-day for the people, a day they look forward to, yes, and remember pleasantly afterward. Old and young, rich and poor, mingle and associate and unbend for a good time, and go home all the better for it. The blushing maiden accepts a kind invitation from some aspiring young man, who enjoys the day all the more with his congenial companion at the fair. And bye and bye he wants to wait on her, not only *fair day* but *every day.*

And thus, not only New England hopes, but New England homes and New England schools are kept up, and the best interests of our nation maintained and preserved.

Let us put into our fairs all that is noble and excellent, and keep out all that is unworthy and evil; so shall we the better serve our day and generation, and make the world wiser, better, and happier.

P. M. AUGUR, *Delegate.*

### WATERTOWN.

The first day of the fair was "Cattle Day," and before noon there were on the ground in orderly array 270 yokes of cattle, and not one inferior pair — a display I never saw equaled but once, at the State fair. If the association had not an exhibition ground perhaps the finest in the State for its size, which is ample, perhaps the cattle would not have appeared so well. The exhibition of trained steers, by boys not much older than the steers, and the trials of strength on two loaded stone boats, took place at the same time, and your delegate felt as much embarrassed as would a spectator of Barnum's circus rings; but time is money on Cattle Day at Watertown, and at five o'clock every team was outside the gates, headed for home, with the white and blue tickets on their horns, and two hundred and seventy half dollars in the drivers' pockets.

The hall on the "Hillside" is a good exhibition building, and had the usual polite advertising agents of smart Waterbury and other merchants. The fruit and vegetable display was not such as one would expect from so rich an agricultural district. Wednesday was "Horse Day," and I was highly gratified at the large number of brood mares with likely looking colts at their sides; it was a surprise, and an intimation that we should in the near future cease to go abroad for that prime necessity, the horse. I wish to acknowledge my indebtedness to President French and Secretary Scoville for kind assistance and attentions.

### TOLLAND COUNTY FAIR.

at Rockville embraces a.much larger territory, and has within its limits Bolton, Vernon, Tolland, and Ellington Granges, and these Granges contain in the neighborhood of two hundred women; with such a constituency and such a backing, the managers of this fair might have said with Patrick Henry in reference to the fight for American independence, "We cannot fail"; and with Hon. E. S. Henry, Chairman of the Committee of Awards on Grange Exhibits, "we are embarrassed by the amount of work done, and by the completeness and beauty of what has been accomplished."

No report from me could do justice to these four shows (for such they were) of the patrons of husbandry: the exhibits of cattle were fine, particularly the butter breeds of dairy stock; also the products of the dairy, both butter and cheese, were extensive and tempting. But the grand success of this exhibition was the splendid collection of vegetables and fruit, abundant and perfect, arranged by experts in artistic style, and yet the art was all concealed by nature. Your delegate was introduced to a lively lady of the Grange between seventy and eighty, and to a gentleman in his prime who, I was solemnly assured, was in his ninety-third year. Surely this was the land wherein has been discovered the fountain of eternal youth. To President Perkins and Secretary Tucker, to Master E. H. Lathrop of Vernon Grange, to Hon. E. H. Hyde, for whom "Hyde Park" was named, and to Hon. E. S. Henry, for hospitality and kind attentions, I would render due acknowledgment.

JOHN S. KIRKHAM, *Delegate.*

The CHAIRMAN. I notice in the report of the delegates that the State Fair has been passed by, for some reason inexplicable to me, and I will call upon some gentleman, perhaps the Secretary or Gov. Hyde, to make a report upon the condition of the society and the exhibition.

Sec. GOLD. According to assignment, Mr. Larrabee was a delegate to that fair and was present, but was called away by a telegraphic message. I was present at the fair, and will state very briefly its characteristics.

The week opened, as you know, very unfavorably, but owing to the peculiar quality of the soil there it rapidly dried away, and the grounds were, during the middle and latter part of the week, in most perfect condition. The exhibitors came forward with their stock in large numbers, so that the society was obliged to expend a very considerable amount in enlarging their accommodations. We had taken in additional territory, which for the time being seemed to be, when the fair opened, perhaps unnecessary; but as it progressed we found that the additional ground that had been taken in was so crowded with exhibits that it was not a rod too much. The exhibit was very complete in all the departments, the various granges adding very much to its success. Enlarged accommodations had been provided for them, which they more than filled. We were obliged, at the last hour, almost, to increase our accommodations in the way of tents for the reception of agricultural implements and machinery. As we looked over the exhibit, we were abundantly satisfied with the demonstration of the progress of interest in the agricultural and manufacturing industries of our State. Financially, the draft upon our resources by reason of the liberality with which premiums were bestowed has left us with nothing to boast of in the treasury, but the funds placed in the hands of the managers by the State and by citizens have been fully distributed, and we hope to the satisfaction of the exhibitors.

Gov. HYDE. And as you have called upon me, I will say in regard to the fair of the State Society that I most fully endorse what the Secretary has said. It was really at its best. It is constantly increasing in interest, and the show of stock is increasing every year; it was never better than this year. It has been increasing in that respect every year, and we hope it will continue from this time forward. As the statistics will be given in due time, it is unnecessary to enlarge upon it.

Adjourned till two o'clock.

## AFTERNOON SESSION.

The Convention was called to order at two o'clock, Vice-President DAY in the Chair.

Mr. JEFFRIES. I will say just a word in reference to the matter of bee stings, which was discussed this morning. The sting of a bee produces only a local irritation in some persons, while in others it creates a serious constitutional disturbance. The first thing to be done is to exclude the air from the injured part. Carbonate of potash and tomato juice will alleviate the pain almost instantly.

Secretary GOLD then opened the question-box and read the following: "Has any dairyman made careful experiments on the effect upon the production of cream of salting cows?"

A single trial was reported, resulting unfavorably.

Secretary GOLD. "Are the eggs from the insect which produces the peach borer all deposited on the trunks of the trees in the month of May, or are they deposited each month of the summer?"

Mr. HALE. My impression is that they are deposited through May, June, July, and into August. Any way, we try to have the trees so washed that if the moth is ready to lay her eggs at that time she will not find it a very convenient place to lay them in.

QUESTION. What is the wash?

Mr. HALE. It is a wash made of soft soap, carbolic acid, lime, and a little Paris green.

QUESTION. Does the same borer afflict plum trees?

Secretary GOLD. Probably, as Harris says it attacks the cherry.

QUESTION. Will washing protect plum trees the same as peach trees?

Mr. HALE. I think that a wash of this kind, put on at the proper season of the year, will keep the insect which attacks the apple, the peach, the quince, and the plum from laying her eggs.

The CHAIRMAN. The lecture this afternoon will be by a Connecticut farmer, a member of the Board of Agriculture; one who, when a mere youth, volunteered to shoulder his musket and go to the front, and remained there until one of the wickedest rebellions that ever occurred was crushed out. (Applause.) I do not know that he would rejoice in any higher title than that of a farmer, but I trust, gentlemen, that the time may come when, if anything can add honor to the title of a Connecticut farmer, it will be conferred upon him. (Applause.) At the close of the war he returned to this State and is now cultivating his own paternal acres in the town of Middletown. You all know who I mean, gentlemen. It is JOSIAH M. HUBBARD, whom I have now the pleasure to introduce to you.

# THE POSSIBILITIES OF CONNECTICUT AGRICULTURE AND OUR DUTY IN VIEW OF THEM.

By J. M. Hubbard.

The key-note of this address is to be found in the word *duty*. I well know that the word and the thought which it represents are not so attractive as are some others which I might select, but for all that, duty is something which we cannot afford to leave out of the aggregate of influences which are to guide, impel, and control our lives. Not only must duty be not left out of 'our lives, it must not be relegated to any unimportant work, or any subordinate place, among the influences which are to control our actions. It must not be so because we cannot afford to have it so. Duty may be far less agreeable than inclination as a guide and companion, but she is far safer. Her clear eye discerns dangers to which interest and inclination are blind; and her firm hand guides us ever in the path of safety.

What we ought to do is the only wise and safe thing for us to do. Duty must not only be admitted into our lives, but it must pervade them. We cannot partition off our lives and say of one part, duty shall not come here. We may as well squarely face and give audience to the truth, that moral obligation takes hold of everything that we do or may do.

Work, play, religion, politics, business, personal life, social life, class life — into each and every one comes this same persistent thought of duty, claiming the right to exercise authority everywhere. We must give the claim consideration, and if we consider it fairly, I think we must admit that it is well founded. The quality of "oughtness," as some writer has named it, finds a rightful place in every part of the field of human activity. We ought, all of us, to be honest, pure, and charitable. We ought also to be industrious. We ought to be wise. We ought to be good managers. We ought, each one of us, to fill his place and perform the work which belongs to it. We ought to be successful, in the best sense of that sometimes sadly abused word. We are obliged to concede that there is not, there cannot be, any department of human life from which the thought of moral obligation can rightly be excluded.

Strictly speaking, duty is an individual matter. Questions of right and wrong are personal questions.

There is, however, a sense in which it is a fair use of language to speak of moral obligation as applicable to groups and classes of people An army, for instance, ought, we say, to be brave, enduring, obedient. It is the aggregate of personal qualities that makes it so, but in our thought the quality attaches to the whole, though there may be a considerable number of individuals who do not possess it. So, also, if three-fourths of the individuals composing an army prove weak, cowardly, and insubordinate, the remaining fourth suffers in consequence thereof, though the men comprising this fraction may fully meet all their individual obligations.

We carry this figurative and illustrative use of the thought of duty into a great many fields of thought, and make use of it in a multitude of connections. We apply it to inanimate objects. We say of an implement, of an engine, of a machine, that it ought to accomplish certain work and bring about certain results. When to us the power seems adequate and the way open, we find no more clear and forcible language to express our expectation of what should follow than this which belongs to the thought of duty. I mention these things because they illustrate the pervasiveness of this thought and may be helpful in some of the applications to be made of it.

Under the principle of association, each individual carries not only his own reputation and welfare, but some share of what belongs to all his associates as well. I am of the opinion that we farmers have not given to the great fact of association and to the obligations which grow out of it, the consideration which belongs to them. The fact of which I speak, and the obligations which go with it, are not matters of choice with us. We *are* a class, whether we recognize the fact or not. We have common interests and common perils. We cannot further these interests or guard against these perils without acting from a broader view of affairs than that which is limited strictly to our individual interests. Other and more than mere material interests are involved in this matter. Besides the individual respect and consideration paid to a man on account of his personal character and work, there is a certain consideration accorded to him on account of his classification. It adds immensely to the compensations of any life, that it is spent in an honored vocation. Every man owes to his chosen vocation the duty of upholding and maintaining its honor and dignity, and placing them upon stable foundations.

It is always necessary to earn these things, and it is sometimes necessary to demand them as well. The debt which the community owes to any avocation which contributes to its welfare is a demand obligation, and unless it is demanded as well as earned, the court of public opinion will not enforce its payment. The drift of this talk has so far been steadily towards an extension of the boundaries of the field of duty. I propose now to speak very briefly of its limitations. If I have given the impression that I regard it as an unfenced common, I shall have to correct it. It is enclosed on every side by the thorny hedge of impossibilities. No one is required to go beyond this fence. It is not the duty of any one to waste his energies upon an impossibility. I know it is a popular form of speech to say that there are no such things as impossibilities, but while we may applaud the speech, we all of us know that it is not true. Indeed, it is not intended to be taken as true. The truth intended to be expressed is that the range of possibility is wider far than we are apt to think. To that I most heartily agree. It is the truth which it is very largely the object and purpose of this paper to enforce. But I don't believe in enforcing this or any other truth, however important, by overstatement. There are impossibilities. Whatever energy is expended in the effort to accomplish them, is expended vainly, and the cost of it is, that some beneficent possibility must go unrealized. It is never the duty of individual or class to attempt impossibilities. It is the duty of class and individual alike to learn the measure of its powers and to know the reach of its opportunities — to bring the one into fullest exercise, and to explore the other to its remotest limit.

Duty has other limitations than those defined by possibility. It is not a man's duty to do everything which it is possible for him to do, even if the thing itself ought to be done. A man should do his own work. If he attempts to do the work of others, which it may be possible for him to do, his own work is sure to be neglected, and the general outcome of his effort is evil rather than good. What is true in this matter of an individual, is true also of a class. Let it fill its own sphere. let it do its own work, and not be misled into going outside and attempting the work of others. It is not the call of duty which summons it to any such excursion.

Undoubtedly it is one of the most difficult of life's tasks for any one to define clearly in all cases the limits of his own work. It is probably true that for every one who is disposed to go beyond the true limit, there are many who would stop far short of it. If it should seem that my words furnish a covert, behind which this latter class may shelter themselves, I give notice that no such use must be made of them. I shall fail of my intentions if I do not so guard and supplement them, that they shall carry no comfort to shirks or idlers of any degree. It is one of the possibilities open to us, and one of the duties laid upon us, to know what we can do. It is only in small measure that we gain this knowledge by instruction from others. We must discover it by original research. It is to be acquired by the application of reasonable tests. Only thus can we learn the reach and limit of our powers, and only thus can we measure and weigh the tasks which lie before us. No one has any business to presume impossibilities to excuse himself from effort. It is only when he has fairly demonstrated them, that he has the right to refuse to waste his energies upon them.

It is with such underlying thoughts as these that I undertake to speak of the possibilities of Connecticut agriculture, and of the duty which grows out of these possibilities and rests upon the Connecticut farmer. It is my purpose to make this talk rigidly and thoroughly practical. I intend to limit the possibilities of which I speak to those which belong to economic agriculture; to that agriculture which is followed as a vocation rather than a pastime; to that by which men as individuals provide for the necessities of themselves and those dependent upon them, and by which as a class of men, bound to each other and discriminated from all other men by the fact of their occupation, they contribute their part to the life of the world. The possibilities of which I speak must be those which are remunerative to the farmer and beneficent to the community in which he dwells. They must be such as will enable him to discharge his duty to himself and to those dependent upon him, and secure for him and for the class to which he belongs, that respect and consideration without which no man or class of men is ever fully paid for good work. Within the limitations thus indicated I believe it to be entirely possible to double the value of the agricultural production of Connecticut within a very brief period of time. I believe that this enlargement could be accomplished with a comparatively trifling additional investment of capital, and that the return from the aggregate capital invested would be materially greater than it is under present conditions. I believe that with this enlargement, the individual farmer would find life more satisfying, and that the farming class would earn and receive an increased measure of respect and consideration from the community at large.

I will indicate some of the lines along which I think this enlargement could be wrought. In many instances there might be a change from products of low value to others of far higher value. The standard of living in the communities among which we dwell, is a liberal one and a growing one. It calls for a great variety of the products of the soil to make up its food supply. Many articles are included in this demand which may fairly be classed as luxuries, but the number able to pay for them is steadily on the increase, and their supply is a legitimate and important branch of agricultural industry. The supply of luxuries always affords a much larger margin of profit to the producer than does the supply of necessaries. I know of no reason why the farming class should forego their proper share of this lucrative business. And I believe that the situation in Connecticut is in many respects exceptionally favorable to the production of agricultural luxuries. Other States may possess more fertile soils, but none has a soil more kindly in its nature or more responsive to intelligent treatment. And no equal extent of territory anywhere can have a greater variety of situations affording almost every conceivable combination of soil and exposure to suit the peculiarities, the whims, one might almost say, of the most capricious member of the vegetable tribe. These are the products which pay the best if you are able to humor their whims. If, therefore, the market calls for exceptionally choice varieties of fruit, or vegetables, or of any agricultural product; and any farmer finds upon his farm the soil and situation, and within himself the skill and patience to produce them, I certainly advise him to meet the call, and make it pay him well. And let no other member of the brotherhood of farmers be envious of his success or think himself in any way or to any degree injured thereby. He is not only not injured, but he is positively benefited by the step which removes an active competitor in the always crowded line of the production of agricultural staples, and at the same time enlarges the field of agricultural production and enhances the importance of the farming class.

I note another means of enlargement by the production of larger yields of staple products from lands now under cultivation. Curious coincidence, isn't it, that the profitable crops are all good crops, that the crops which just about pay their way are average crops, and that the unprofitable crops are all poor crops. With a little qualification, I think the rule will work both ways. There may be now and then a good crop which is not a profitable one, and it is possible that some average crops may not pay their way, but I can hardly conceive of a case where a poor crop could be other than an unprofitable one.

It is possible, of course, to enrich a field to such an extent that a portion of the plant food in the soil may be wasted, and the expenditure which such portion represents prove in consequence a total loss. It is possible to expend labor in tillage beyond what the returns from the crop can pay for, and yet the unquestionable truth of what I have stated in regard to the profitableness of different grades of crops forces us to the conclusion that over-manuring and excessive cultivation are not the common faults of Connecticut farmers. Suppose that any average farmer should determine to increase the yield of his ordinary crops fifty per cent. by additional fertilization and more thorough culture, with no better understanding of the subject and no better appliances for the work than he now possesses: what do you think the financial outcome would be? To my own mind the probabilities are very strong that his profits would be increased, or possibly his losses would be decreased, or possibly again the balance would be changed from the loss to the profit side of the account. But this is supposing an almost impossible case, for this reason. Just as soon as a man determines to spend his money in additional plant food to invest in a crop, he commences to investigate the subject. He tries to find out, so far as he can, the principles upon which these substances act. He turns to the experience of others for light to guide his steps. Judged from a scientific standpoint, the knowledge he acquires may seem exceedingly crude and imperfect, but it is a vast improvement upon anything which he possessed when he had no financial interest, or only a very slight one, in the matter.

In the application of fertilizers, no matter what the field or crop, there is somewhere a point, to stop short of which involves loss or diminished profit, to go beyond it occasions waste. It should be the ambition of every good farmer to know as accurately as possible the location of that limit, and to approach it in his practice as closely as possible without actually overstepping it. I have already recorded my conviction that the great majority of farmers stop far short of it. For almost everyone there is no risk whatever in taking one step forward. Having taken the first step he can determine whether or not it is best to take another. My own impression is that a good many forward steps might be taken by the average farmer before he reaches the danger line of too liberal manuring or too thorough culture. We are not left to work out all these problems without assistance. Men of science have placed themselves at our service, have pointed out to us sources of plant food, and made known to us the laws governing the use of these new materials, until it is almost true that the resources of the universe are at our command, so far as we are able to make use of them. These men are ready to help us in the further problems which throng our pathway upward and forward. It is the glory of modern science that it concerns itself with the affairs of daily life. It no longer dwells afar in serene contemplation of high mysteries, but it has put on the laborer's garb, and taken its place at his side, ready to help him in any work for the welfare of the race. Its proffer of assistance should be met and responded to with all cordiality. If science is going to be practical we can be scientific, and scientific farming must come to mean that which is most practical and profitable of all.

Men of skill have placed themselves in our service, also. They have given us implements of tillage which render possible and easy a very high standard of cultivation. The possibilities which are opened to us by the two gateways of ample supplies of plant food and effective implements of tillage are as yet but little apprehended. We are not to enter here rashly or blindly, but neither ought we to stay outside. If we come with earnest, reverent spirit and persistent purpose, our reward will be great As a preliminary, however, to the liberal application of fertilizers to many of our cultivated fields, and the employment of improved implements upon them, certain ameliorations of their condition should be made.

I think I have somewhere else said that what Nature gives to the farmer here in Connecticut is not a farm but the materials out of which he may make a farm. The trouble with too many of our farms is that they are not more than half made. Our ancestors got them into shape so that they performed their part fairly well in the coarse machinery, the slow movement, and the crude processes of a primitive agriculture. But we must have something different for to-day. The movement is accelerated, the machinery is balanced more delicately and fits more accurately, and the product is finer and more valuable. Our fathers did their work, and did it well, but we have our own work to do — not theirs to do over again. To a considerable extent, farms which were good farms in the days of our fathers, have got to be made over again in order to be good farms according to the standard of to-day. Nature has given us much productive soil, mingled with rocks, and saturated with water. Under the old conditions fields might be cultivated and paying crops gathered in spite of the rocks and the water. But conditions have changed, and we can do this no longer. And there is not a bit of use in grumbling at Nature for this condition of things. She has a way of making us her partners in work and giving us enough to do so that we earn what we get. It is ours to separate the soil of our fields from whatever interferes with perfect culture, or stands in the way of highest production. If there be excess of water the land must be drained. If there be stones or stumps amounting to serious obstructions to cultivation, they must be removed. If the field be of such outline or grade as to involve serious disadvantages in working it, the resources of engineering must be brought into play to reduce these disadvantages to a minimum. It is along the line of this reconstruction of old farms and fields that much of the increased productiveness and profit possible to Connecticut agriculture must come.

A material extension of the area of culture is the final specification which I shall make of the means by which the productions of Connecticut agriculture are to be doubled speedily and profitably. New fields and farms are to be made, as well as old ones remade. In many cases the making will be but little more than the remaking. And modern science and skill have not only shown us how to feed a crop, and where to find the food for it, and how to furnish by tillage, so far as is possible, all favorable conditions for its growth, but they stand ready to help us also in all the operations of making a farm out of any possible materials. The proper function of dynamite is not to murder Chicago policemen or to destroy the property of the man you don't like, but rather, for one thing, to shatter and tear rocks and stumps from what is to make your fair and productive field.

Many of you remember the old-style formula for advertising a farm. "For Sale: A farm of 150 acres, suitably divided into meadow, pasture, and woodland," etc. Somehow the impression prevailed, and I think is not yet wholly obliterated, that these divisions were determined by natural causes, and must be permanent. It was a daring act to transfer a field from the pasture to the meadow division. And yet it is true that setting aside those which are utterly impracticable, the difference in the productiveness of different fields is owing far less to natural conditions than to our treatment of them. Give the old moss-grown, bush-infested pasture the same fostering care you do your favorite cultivated field, and it will give you the same returns.

This view of the possibilities of Connecticut agriculture is supported, not only by the considerations which I have stated and which furnish as I believe a good foundation for all that has been asserted concerning them, but it is also sustained by a large number of practical demonstrations on every hand. The successful farmers of Connecticut are doing to-day just what I have here declared may be done by all of them. What proportion of Connecticut farmers may fairly be rated as prosperous? According to a high standard, one in ten ; according to a moderate standard, one in four ; according to a low standard, one in two. I name these proportions almost at random, for the range of judgment is wide. Take any standard of judgment you choose and make inquisition as to what the successful class is doing which discriminates it from the unsuccessful one. You will find that the members of the successful class are doing some one, or more than one, of the things which I have indicated as among the economic possibilities of Connecticut agriculture. Open your eyes and you may see on every hand men who have bent their energies to the production of rare and choice products to meet the demand of the markets, and who have won a most gratifying success by so doing. I rejoice at every such instance which comes to my knowledge. A diversified production brings greater development to the agricultural resources of any country, and adds thereby to its strength and importance.

You will also find among the successful class those who, while they have made no change in the nature of the productions, are producing the old staples in much larger quantities from the same fields. They are making use of modern facilities and lately discovered resources to bring the productive capacity of their fields up to the point of highest profit. You will note that they all find this point coincident with a high rate of production. All experience as well as sound reasoning enforces the lesson that poor crops are never profitable crops

And I think you will find instances of success in sufficient number to illustrate and demonstrate the truth that a large extension of the cultivated area is among the economic possibilities of Connecticut agriculture. I wish to direct especial attention to this point. It has for me a peculiar interest, and that for several reasons. It is a possibility to the full extent of which my own mind has only recently awakened. And this awakening has come to me more through practical demonstration than by any course of reasoning. I know it can be done, because I have seen it done, and in a small way have done it myself. I am able to look with a large measure of satisfaction upon the field of a neighbor adjoining my own, where my faith and judgment has been amply justified by the transition from a stony, bushy, moss-grown, poverty-stricken pasture to a productive, cultivated field. While I am not able to give figures of cost and yield, I risk little in saying that the renovation of this field has paid its own way almost from the start, while the value of the property has certainly been doubled by the operation. I am able to look with surprise and admiration upon another tract of land a little removed from my own, where a larger faith and a more daring judgment than my own has also been justified by a conquest of difficulties and a triumph over obstacles in face of which I think I should have retreated. If I were called upon to point out the two most successful farmers in my neighborhood, my selection would fall upon the two whose work I have cited.

I am interested in this particular branch of the agricultural possibilities of Connecticut because of its extent. I think that a few if any of us realize it. I am living upon the farm where all my life, with the exception of a period of ten years. has been spent, and I have studied its capabilities long and carefully. I thought I understood them pretty thoroughly; but these old and familiar fields contain resources and exhibit possibilities which I have only very recently realized. Beyond question they also contain that of which I have as yet no conception. From time to time there breaks in upon me, like a revelation, a sense of what might be done with this or that piece of ground, and from thenceforward I see it as I never saw before. I believe that upon almost every Connecticut farm its owner may repeat continually the experience of Columbus and be himself a discoverer of new worlds. We think the farms which we buy or inherit are ours, but our possession of these farms is at best but partial, and at most amounts to but little more than keeping others off from them. Indeed, this is just about what the legal title to land amounts to. It keeps others off and gives the owner a chance. If beyond that we are actually to possess our farms we must first discover and explore them; after that we must conquer them; them we must construct them, and finally; we must maintain then. This matter of possession is in some sense a mutual thing between the farm and its owner. If one is thoroughly to possess his farm he must in turn be possessed by it. He cannot get much from it unless he gives much to it, and his gifts to it must include, not only materials and labor, but the higher qualities of his nature, his energy, his faith, his love.

Many of these new possibilities of our agriculture are unlocked for us, as I have before indicated, by the key of science. Many others are open to us by the application of mechanical skill to the operations of agriculture. A goodly number grow from the constantly increasing needs of advancing civilization. These are the strong reinforcements which stand ready to unite their forces with ours, to put themselves at our command, and serve under the glorious banner of agriculture in the conquest of whatever difficulties may confront us.

I am interested in the possibility of a general extension of our agriculture, for the further reason that it adapts itself to the ability, natural or acquired, of a much larger class of our people than does the line of specialties. It is not every one who can enter successfully upon the production and marketing of what I have designated as agricultural luxuries. A peculiar natural adaptation, and a somewhat exceptional training, are necessary to qualify one for success in this line. Where these exist they should be directed into that line of production which will yield to them the largest amount of personal satisfaction and afford them the greatest pecuniary compensation. But while the men who can do this work may be exceptional and rare, there is no farmer worthy of the name who cannot enlarge his business by extending the area of culture upon his farm and increasing the productiveness of his fields, when the possibility of doing this with increased profit is open to him and he can be brought to see it. It is my firm belief, that the resources of this nature which to-day invite development in the State of Connecticut are very large. I state deliberately my judgment, based partly upon personal observation, and partly upon information drawn from authentic sources, that the agricultural resources available for profitable development under existing conditions are more thoroughly utilized to-day in such western States as Illinois, Iowa, southern Wisconsin and Minnesota, and eastern Kansas and Nebraska, than in this old, long-occupied, and in many respects highly-favored State of Connecticut. "Brethren, these things *ought* not so to be," and you and I, members and representatives of the farming class, have a direct responsibility in the matter which it is the object of this address to recognize and enforce. I desire to set forth those considerations of interest and advantage which may attract us, and I desire also to appeal to the sense of responsibility and the feeling of duty which may impel us forward in the right path. We are so made that in many things we need to be impelled as well as attracted. There are times when even a good horse needs the spur in addition to the call. Considerations of interest alone will not always move men to do the thing which is best for them to do And whether a man makes formal acknowledgement of moral obligation as one of the controlling forces of his life or not, few men are able, even if they try, to free themselves wholly from its grasp.

"You *ought* to do this thing," when fitly spoken, is still about the strongest utterance of human speech. If it finds a response in the heart of the hearer, he may writhe and turn and flee and hide, but he cannot escape from it. I desire to set this sleepless, tireless, pitiless pursuer and avenger upon the track of every Connecticut farmer who fails or neglects to do what he ought to do with the possibilities which lie open to him.

It will be said, and said truthfully, that difficulties will be found in the path of duty thus pointed out. No path which leads to valuable results is free from difficulties. They are never a reason for turning back; they are never a reason for failing to go forward; but they should receive consideration with a view of determining the best method of overcoming them. With this view I mention some which suggest themselves to my mind.

Where is the capital for these extensions and improvements to come from? What I propose contemplates an expenditure of money, a permanent investment of capital, and the farming class is not supposed to be in possession of any great amount of free capital. It may be well enough to recognize right here the fact that the business of farming as now carried on undoubtedly suffers from a deficiency of active capital. And the enlargement which I believe in, and hope to see, certainly involves the employment of a larger amount of capital in the active operations of our business as well as the permanent investment required for the construction and reconstruction of our farms.

As I think of this matter a temptation to sarcastic treatment of it comes over me. Of how much money, I should like to know have Connecticut farmers suffered themselves to be plundered within the past twenty years by devices so many and varied that I cannot attempt to catalogue them, and to which they have been exposed because they hadn't sufficient faith in their business to invest their gradual accumulations in their own farms. How ready and sufficient and always pertinent the answer would have been, to the whole tribe of wily, smooth-tongued scoundrels, who under so many pretexts are seeking to draw his hard-earned dollars from the farmer's pocket, never in any form to return, if he could say to them,— Whatever capital I have to invest goes into my farm until it is brought to the highest profitable standard of production. Taking this position you meet the enemy upon ground of your own choosing, and can vanquish him. But let him draw you upon ground which he shall select, and defeat almost certainly awaits you. But I am well aware that lament is profitless except as it may serve to warn us of future dangers. The money which farmers have wasted in the past will never do the work of the future. If, however, it can now be diverted from wasteful channels, much may be done with the slow accumulations of the average farmer.

The improvements needed can be advantageously made a little at a time. The farmer is not compelled to raise a large amount of money to be expended at one time, in order to enter upon the work to which I have called him. The work to be done adapts itself to the nature of the farmer's accumulations. He can make deposits in his farm as often and in almost as small amounts as in a dime savings bank, and no savings bank in existence will pay him such dividends as will a well-managed farm for the money needed to improve it. In the last extremity a farmer may borrow money to improve his farm. I do not wish to advise this. It is dangerous to borrow money for any purpose, but I believe as little danger is incurred in borrowing for the purpose herein indicated as for any which could be named,

Perhaps the lack of fertility in our soil will be regarded by many as a very serious obstacle in the path of extension and improvement. It is an obstacle, but not one at which we need to be frightened. If we have made good use of our opportunities for learning we know something more about fertility than we did a few years ago. We are all familiar with talk about exhausted soils. The old definition of this term would read somewhat as follows: "A soil in which no single element of fertility remains." We have learned better than that. We have learned that a soil may cease to be productive, and be classed as exhausted, when of all the elements of fertility it lacks but a single one. When we find what that lacking element is, the task of restoring such a soil to a condition of fertility and productiveness is comparatively easy.

Some of the difficulties which confront us grow out of the development of agricultural production at the West. If any of these are insurmountable we must adapt ourselves to the conditions which they fix for us. If they are not insurmountable, as I believe to be true of most of them, we must conquer them. But we must not fall into the great mistake of assuming that every development of agricultural resources elsewhere is hostile to our own interests, even though in the readjustment which follows we may encounter many serious difficulties. That which was suited only to the old conditions must be rejected and cast aside whenever organized life takes on a new development. The discarded organ or enclosing shell has served its purpose, and we need not mourn its loss. What we should do is to bend all our energies to the work of filling the new possibilities which lie open to us. Western competition has compelled us to drop many lines of production and methods of business which were profitable to us before we encountered this new and disturbing element. But in the larger growth which the nation is taking on because of the energy and productive capacity of the West. it must be strange indeed if we cannot find for ourselves a function both useful and profitable.

This northeastern extremity of our country has been called the head of the organic national body. Without implying anything offensive to other sections, there is enough of fitness in this illustrative designation to justify its use It is probably true that the contribution which New England makes to the national life has in it more of controlling and directing power than what comes from any other like portion of the whole country. It is probably true that work performed by New England, taken as a whole, is more delicate in process, more refined in result, demanding more of thought, and if well done, commanding higher compensation than what is done in other portions of our land. And this may be as true, and ought to be as true, of the agriculture of New England as of any other department of her work.

The opportunities which are open to us are not only enough to employ all our energies, but they are of that class which call out our best activities, afford all our powers their fullest development, and reward us with the most liberality. Shall we complain because opportunities of a lower grade are withheld for others' benefit? We cannot have everything. We cannot seize the better opportunities without letting go our hold upon those which are inferior. Indeed, we owe the better opportunities to the fact that the inferior ones are taken from us by hands able to fill them better than we can. What would the country be without the elements which the West contributes? Narrowing the question a little, what would be the condition of New England agriculture if there were no West?

The interchange of products between the East and West has two sides to it. It is a matter of giving as well as taking. The West sends us its crude products, and receives in return those into the production of which the element of labor enters in much larger measure. Because of one man living at the West, it is possible for two additional men to live at the East, and these two men and their families have other wants besides those which the man at the West supplies. If the man at the West supplies them with meat and bread so cheaply that they have much money left to spend for peaches, and strawberries, and cabbage, and celery, and eggs, and poultry, do you not see that the opportunity thus afforded to the Eastern farmer is superior to that taken from him?

So East and West and North and South may work together even as heart and brain, as hand and foot, as muscle and nerve contribute each their part to the welfare of the whole body, each receiving in turn from the well-nourished body all that it needs to maintain it in the perfection of health.

In the consideration of this subject I have from the first been aware that a question lay in my path which to many minds would seem to present a serious difficulty in maintaining the positions I have assumed. By what philosophy do I account for this state of things? There is a cause for everything, and if it be true that Connecticut farmers are not improving their opportunities, are not meeting their higher obligation, are not filling the sphere of action and influence open to them, there is a reason for it all, and any discussion of the theme would be imperfect which did not attempt to discover and state this reason. Are Connecticut farmers as a class inferior in ability to the other classes in the community, or to their brothers in the same occupation in other parts of the country? This is the ugly question which has been staring me in the face with more or less distinctness during all my thought upon this general subject. I am aware that there is a class of minds which will be inclined to accept this suggestion as the natural and easy solution of the difficulty, as the true philosophy of the situation. The stock, they say, has deteriorated. It has been constantly depleted of its better elements until the natural and inevitable result has been reached in the degradation of that portion which remains to represent it in the old homes. Those who have emigrated to other States and Territories, and who have abandoned agriculture for other callings, have ever been, they say, the more ambitious, intelligent, and energetic of their class, and what you see and complain of in the condition of Connecticut agriculture, is but the natural, inevitable result of this process of depletion.

I state this view of the case baldly and strongly, without relief or disguise; but every instinct of my nature forbids me for a single moment to think of accepting it as a solution of my difficulty. And I am inclined to claim a somewhat exceptional privilege in speaking upon this subject, from the fact that I fairly belong to both classes. Inquiry was made in the Grange meeting here, the other day, for a brother from a neighboring town. The response was "He's here, but he has gone home." I think this accurately expresses the feeling with which my Western friends regard me. I have never ceased to be of them and with them, though it has been many years since, from their point of view, I went "home." I have that knowledge of both classes which is derived from membership. I have been impelled both by the powerful impulses which send the young man away from home, and held by the strong ties which anchor him to the ancestral fields.

I believe I am entitled to give expert testimony with regard to the matter, and I declare to you that the considerations which determine who out of the family group or the neighborhood circle shall go out into the world to seek for fortune in other spheres, and who shall stay to guard the interests which cannot be removed, do not tend to the formation of a superior and inferior class. Some of the motives which keep young men upon Connecticut farms make their appeal to the finest and best elements of character, and could not be resisted and denied without degradation. I offer, as further evidence that the stock of humanity in rural Connecticut has not deteriorated, the fact, made evident by common observation, that the representatives which it continually sends forth to measure themselves with the strongest in every walk of life and every field of human activity, do not take second rank anywhere. I have no time to particularize under this head. I mention the fact as one within the knowledge of you all, and to which I assume that you will give due weight.

What, then, is the true solution of the difficulty? What is the matter with so many Connecticut farmers? Speaking frankly, I think they are somewhat demoralized. I use the term, of course, in its military significance. It means a lack of confidence in themselves, individually and collectively; a lack of faith in their ability to conquer the difficulties before them; and a want of determination to go ahead and test their ability to the utmost. Some may object to the use of a term implying moral dereliction or deficiency in such a connection. The story is told of a newly appointed officer in our late war, who brought a company of recruits to the field, and when asked, with reference to some contemplated service, if the "morale" of his command was good, replied, "The very best" Many of his men, he said. were church members, and Sunday-school teachers and scholars, and all were recruited from the moral classes. All of which might be true, and still they might quail in the awful tempest of battle, and fail to win victory for themselves and their cause.

The farmers of Connecticut are not by any means inexperienced recruits, but demoralization may result from other causes. They seem to me more in the condition of men who have been compelled, as the bravest and best of soldiers sometimes are, to fall back before overwhelming odds, to give up position after position, and yield trophy after trophy, until they are not sure of their ability to hold or win anything. Let me illustrate by a brief recital of a passage from my own experience as a soldier. It was my fortune once to be associated with a command situated much as indicated in the preceding paragraph. Day after day, and night after night, the alternative presented to us was retreat or annihilation. We knew that reinforcements were on the way to our assistance, but whether or no they would reach us in time to save the great interests for which we were putting forth our best efforts, we did not know. I recall with perfect distinctness the last movement of retreat. I think I could go now to the low ridge of land in western Missouri where we formed our last line of battle in that movement, and with gloomy foreboding, but in a spirit of sullen, dogged endurance, awaited another onset of the foe. That onset never came. Before it could be delivered, a headlong rider brought us news of the close proximity of the reinforcements whose coming had been so long delayed, and his concluding words to us were these: "The general orders an immediate advance all along the line."

The scene changed as by magic, and as the word of command ran down the long line it broke into column, and sweeping across the intervening valley it charged and recovered the hill from which it had just been driven, and pressed forward to complete victory. It was not particularly gratifying to our vanity to learn, as we afterwards did, that the force before which we had retreated that morning was really inferior to our own, that the main rebel army had been in full retreat for hours, and that what we had in our front was but a strong rear guard left to hold us in check while the main body made good its escape. If we had but known, we might have grasped an earlier and a more fruitful victory.

Something like this, as it seems to me, is the position of us who are guarding the agricultural interests of Connecticut to-day. We could not withstand Western competition when it made its first onset upon us. We had to retreat. They captured our market for breadstuffs first. That for beef and pork followed. We only in part rear the animals in our service, and produce the food which sustains them. And if we are to keep our market for dairy products, hay, vegetables, tobacco, or any important farm product, we have got to fight for it. But meanwhile the situation has changed in our favor. Reinforcements have joined us. Science and skill are on our side. The position we now occupy is one of great natural advantage We can hold it. Not only can we hold it, but we can recover much that has been surrendered. What we need is a presence and a voice among us like that of Sheridan at Winchester, which shall thunder in our ears the authoritative call, "Face the other way, boys! face the other way!" "We are going to recover every lost position. We are going to win back every surrendered trophy."

We need an appeal like this to come home to mind and conscience in such a way as to awaken us to our interest and arouse us to our duty.

I cannot play Sheridan, but there has rested upon my mind for a long time the burden which the situation imposes upon all who can perceive it It is something like what came to the old prophet and compelled him to "Cry aloud, and spare not." Necessity is upon me, so far as I know the truth in this relation, to proclaim the truth; so far as I see the way, to strive to point out the way. I wish I could lead the way, but there are a thousand better leaders than myself already at the front, and, Mr. President, if you will tolerate one more military illustration, this utterance of mine may be taken as a somewhat bungling, but thoroughly earnest effort on the part of Corporal Hubbard to "close up the rear rank."

What, Mr. President, ought to be the attitude of mind and heart with which we should approach any subject which affects the honor and dignity or the material interests of the State of Connecticut? Should we handle such a theme in the spirit of fault-hunting, and speak of her rocky hillsides and sterile plains, her rigorous and capricious climate, the abnormal development of thrift among her people, overstepping the bounds of honesty, and making the wooden nutmeg her emblem, the excessive manifestation of economy running into degrading niggardliness? If we seek for such things we shall find them. If we concentrate all our attention upon them, we can see nothing else. But these are not the characteristic features of Connecticut soil, climate, or people. These or their equivalents are to be found everywhere. The features which individualize Connecticut are other than these, and what some of them are I have endeavored to point out.

We have no reason to be ashamed of her. She is worthy of our love, and she is able to compensate our labor. She stands to-day between a glorious past and a future which is largely in our hands, but which, if we prove ourselves equal to the exigency, and faithful to the trust, will prove more glorious still. Connecticut of the past; hear what one of her most gifted sons has written of her and her people:

Still her gray rocks tower above the sea
That crouches at their feet, a conquered wave.
'Tis a rough land of earth and stone and tree,
Where breathes no castled lord or cabined slave;
Where thoughts and tongues and hands are bold and free,
And friends will find a welcome, foes a grave;
And where none kneel, save when to Heaven they pray,
Nor even then, except in their own way.

Her's are not Tempe's nor Arcadia's spring,
Nor the long summer of Cathayan vales.
. . . . . . . .
Yet the wing
Of life's best angel, health, is on her gales.
Through sun and snow, and in the autumn time,
Earth has no purer and no lovelier clime.

Her clear, warm sun at noon; the mist that shrouds
Her twilight hills; her cool and starry eves,
The glorious splendor of her sunset clouds,
The rainbow beauty of her forest leaves,
Come e'er the eye in solitude and crowds
Where'er his web of song her poet weaves,
And his mind's brightest vision but displays
The autumn scenery of his boyhood days.

Of her people, says this poet:

. . . View them near,
At home, where all their worth and pride are placed;
And there their hospitable fires burn clear,
And there the lowliest farmhouse hearth is graced
With manly hearts, in piety sincere.
Faithful in love, in honor stern and chaste,

In friendship warm and true, in danger brave,
Beloved in life and sainted in the grave.

And when you dream of woman and her love,
Her truth, her tenderness, her gentle power,
. . . . . . . .
Be by some spirit of your dreaming hour
Borne like Loretto's chapel, through the air
To the green land I sing, then wake, you'll find them there.

Connecticut of the future — what shall she be? Populous and wealthy cities will dot her territory here and there; thriving manufacturing villages will be sprinkled up and down her valleys, strung together, all of them, like beads of varying size and color upon the railway thread; and in them the keenest business men on earth will direct affairs, and the throb and hum of busy industry will never cease. The men who have in charge this part of the future of Connecticut are going to do their work.

What of the space that lies between these cities and villages? Shall it be a desert? Shall it be a wilderness? Shall it be a game preserve? Or shall it be a succession of fair and fruitful fields, and the seat of multiplied groups of rural homes, where comfort abounds, where happiness abides, where dwells a population in whom the qualities which our poet so graphically depicts are still the foundations of character, but upon those foundations a structure is built, into which is wrought all that is valuable in the harvest of progress garnered by the nineteenth century?

What answer, brother farmers of Connecticut, have you and I to make to these questions? Our work will be our answer; the swiftly passing years will make indelible record of it; its character will depend entirely upon whether or no we do our duty.

A solo was then sung by Mr. Cornish, to the great acceptance of the audience, after which the discussion of Mr. Hubbard's paper was entered upon.

Mr. SHERWOOD of Greens Farms. I am always interested in whatever Mr. Hubbard says; I think we always go away improved after listening to him. I only want to say a very few words. I think that one of the difficulties in the way of our success as farmers is that we do not always realize the fact that a man who is successful as a farmer is just as good and that he achieves his success in just the same way that any other business man does. Now, we cannot expect any man to go into a business that will not pay and that he does not believe in, and so I should say that the first thing necessary to success is for a man to believe in his business. My experience in farming has not been very great, but it has extended far enough for me to have come to this conclusion, that just in proportion as I took care of the land it paid me. I never knew it to go back upon me. And, more than that, I do not believe that any one of us has ever yet found out how much a good piece of land will produce. Another thing to be said is, that if anybody wants to make progress on a farm, he wants to begin on the very best land he has. The gentleman says we do not have any too much money. It is one of the tricks of the trade, as I look at it, to make the farm support its owner and grow better all the time. We cannot do it in any other way, so far as I have ever been able to find out, than by improving the best land we have got. You will grow rich in that way, if any, and your farm will grow rich.

What makes a successful farmer? How many farmers are there in Connecticut who know whether they are successful or not? What makes any successful business man, and what is a successful business man in any other line or calling? I think, Mr. President, that there are multitudes of farmers who can make a good living all their lives long, and when they die the result of their work shows not only in the character of the society in which they have moved, but in the shape of pecuniary profit. I think we are often carried away by bubbles, by the stories we hear of the profits of business outside, so that we do not know how well off we are. We want to go to the foundation; we want to take our bearings.

I think I have said enough, but I have attended these meetings for some ten years or more, and I believe that agriculture in Connecticut is improving, from the very fact that the men who come here show it in their presence, in their actions, in their talk. I do not believe that we ought to be demoralized. I think we are on the way to improvement.

(Senator **Kirkham** in the Chair.)

Secretary **Gold**. "Has any one present had any experience in hiring farm help and paying them a percentage of the profits instead of regular wages?"

Mr. **Hoyt**. I have never had any experience in dividing profits, but I have had experience with my help taking all of the profits. (Laughter.)

Mr. ———. Has any one had any experience in working a farm and allowing his help a certain part of the profits?

Mr. **Lee**. I do not know how help can be paid by a percentage of the profits unless they agree also to share a percentage of the losses. I should like to hire men with that understanding, but it is all foolishness, in my opinion, in any business, to suppose that the hired help have a right to a percentage of the profits. If the farm help in my section of the country will live as economically as the farmers who employ them, they will get rich; but when they want a right to all that grows out of it, they cannot work for me. I have come to the conclusion that the less I do the better off I am. That, of course, may be all my fault, but as the price of labor is now and the price of commercial fertilizers, if a man has got to hire help and pay interest on his farm, as I have to, and buy fertilizers, he had better sit in the shade and enjoy the beauties of nature; at any rate, when wheat flour can be bought for five dollars a barrel In regard to what our future is to be, and more especially what a successful farmer is, that is a question which each one must answer for himself. It seems to me a farmer is successful if he does better than his ancestors did on the same land, if he raises a family and sets before them an example which it is safe for them to follow, pays his honest debts, and gets a living. I hardly think it possible for a man to get rich at farming.

Mr. **Platt**. When the author of this question will give us some process of discovering profits, I will then agree to answer him about the division.

Mr. ———. I think a successful farmer is one who makes two blades of grass grow where one grew before.

Mr. BARTHOLOMEW. I have had no experience that will enable me to answer the direct question, and yet I have had something which may possibly be construed in that line. When I find a man I think I want, I ask him his price. If I think it is a reasonable price I say to him something like this: "If you are the man I want I am willing to pay you all I can afford to. I am going to work myself and I want you to work for me faithfully. If we succeed you will be sure of your pay at least, and perhaps you will get more." The idea I wish him to take is just this: "We are going to undertake to raise crops on the farm to get pay for both of us, and I want you should be mutually interested with me and help me to raise good crops so that we can both get our pay out of it." The last man I had stayed with me about sixteen months; I was very well satisfied with him, but he got married and wanted to go into business for himself. I have just started another man under a similar bargain.

Mr. WHITTLESEY. I am thinking that we do not, perhaps, look at our circumstances in exactly the right light. In what part of our country can a man find so many comfortable farm homes, where plenty, peace, and happiness are found, as in the State of Connecticut? We hear a great deal of complaint, but in my opinion there is no better spot for a farmer to live on the face of the earth. (Applause.)

Mr. BILL. I have a number of men whom I have hired right along for twenty years past, more or less, and I am satisfied that they are willing that I should have a profit on the labor beyond what I pay them. I have no ten hours or eight hours or any other system to go by. They are there early in the morning, and if I ask them to, or if they see it is necessary for them to work beyond the ordinary hour, they are always ready, and never grumble. They are a class of Americans who are always ready to do their duty and ready to do all that the farmer asks at their hands. I believe if the farmers of the State of Connecticut would rely more upon American-born citizens they would have just such help as there is in the neighborhood in which I live. My men once undertook to play the ten-hours system upon me, but they never undertook it but once. I told them it was the last year, and it was the last year. With that one exception I have never had any reason to complain that they were not willing to give me beyond what I paid them, and I honestly believe they have done it. Now I say to the farmers if, instead of going to the city of New York and paying expenses every few weeks to get foreign help, you would build small houses, suitable for the right class of tenants to live in, you would have a class of men around you who would be willing to allow their employers a profit beyond the labor. (Applause.)

The CHAIRMAN. Will you leave the post-office addresses of those men, Mr. Bill? (Laughter.)

Mr. CABLES. A few years ago we had a very likely man at work for us, he was an Irishman, and was smart when he was a mind to be, and when he was not a mind to be he was not very smart. I wanted him to engage to work for a year, and in order to give him some inducement I told him I would pay him $20 a month (I had been paying $18) on condition that he did certain work on the farm that year. My business is raising garden truck. We were raising cabbages then largely, and I said to him, "If we raise so many more cabbages than usual I will give you so many cabbage-heads." He agreed, and the result was we had a splendid crop. Since then I have said to my men, "I will give you so much a month." I hire them low enough. I get my men in New York. I know nothing about them, but I say to the agent, "Don't offer the men you send to me over a certain price." I always pay the men their expenses, which I do not agree to do, and I always pay them two dollars a month more than I agree to pay them, if they are worth anything; if not, I pay them just what I agreed, and I have no trouble. I have had one man five years, and another man two, and he has just hired out for another year. When I get a good man I pay him well. That is the whole secret. I have no trouble in hiring men. If one of my men leaves, I can send to New York and get another at any time. But if you hire this class of men, there is one thing you must not do. Don't go out into the field with them to work. If I put myself on a level with this foreign class of men I don't get any work done when I am not in the field, but if you put one of their own class ahead you will have no trouble.

Mr. STANLEY. There is one feature of the farming business which was touched upon by Mr. Hubbard which is very important, and that is the want of confidence on the part of farmers in their business. I have said, and I say it again, that I do not care where a man is from if he is taken through the Connecticut valley ten or fifteen miles the other side of Hartford and down this side, he will say that he never went through a better section of country or a more productive country in the world. And yet you find a great many of those farmers who are always grumbling and saying that farming does not pay; they say they are growing poorer all the time. You go up into Vermont, where there are not half the facilities for farming to advantage that there are in this part of the country, and you will find the people there at work with perfect confidence in themselves, and they are prosperous; but here in Connecticut, as I said, our farmers are a set of grumblers. Instead of going to work with confidence and using the means they have, they sit down and grumble and complain that the rich farming lands of the West have ruined the prospects of the farmers of New England. We sit down in that way and do not do half that we might to keep our courage up in the way which is necessary if we would make the farming community in which we live prosperous and successful.

Mr. CHEEVER. The question which is asked, whether any farmers are in the habit of paying their hired laborers a proportion of their profits instead of wages, is one which suggests another. I want to ask the farmers in this audience how many of them can stand on their feet and say, "I know by my books just what my profits are and what there would be to be divided?" I would like to have those who can do it stand right up.

Mr. LEE. I can raise steers and I can sell them without the help of hired men. That is what I am doing, and I am improving my farm. I cannot tell how much better I am off, but I know I am better off, and I am raising three tons of hay where my father raised one. I am making two blades of grass grow where one grew before, and two bushels of grain grow where less than one grew before.

Mr. ———. I believe it is all nonsense to say that there is not any money to be made in farming in New England. I have just returned from Providence, where I saw a man who told me that he cultivates sixty-three acres. He said, "I started with absolutely no capital. I bought my father's farm and agreed to pay $30,000 for everything. I have paid for everything, and I can clear every single year, above all my expenses, over $10,000." You say, "Did you believe it?" Yes, I believed it from the looks of things. He has no trouble in getting men, because he pays them more than anybody else will. I met another man who is raising garden truck. I asked him, "Is there any money in spinach?" He said, "I will tell you how much there is. We took from five acres of spinach seven thousand and odd dollars." And yet we hear farmers say, "There is no money in New England in farming." It is not so.

Mr. SHERWOOD. Who buys the western farm mortgages? It has been my misforture for the last seven or eight years to be in a broker's office, and I have seen a good many farmers who supposed they had been working at a loss, but most of them have western farm mortgages.

Mr. BILL. You have now got upon the right kind of talk. A little while ago when a gentleman over there asked why it was that we did not see the young men here, I felt as though I didn't want to see them here if we were going to make it out that farming was such poor business that we were all going down hill instead of up. Now you have got on the kind of talk that young men ought to hear for themselves. Go on talking in that direction. I am with you. (Applause.)

Mr. ———. I would like to ask if there is any case on record where a farmer has failed and paid fifty cents on the dollar?

The **Chairman.** Never by farming.

Secretary **Gold.** "Is dehorning cattle a practice to be encouraged?"

Mr. **Cheever.** I have never seen the operation performed, and I know really nothing practically about it. I have talked with the man who calls himself the apostle of dehorning at the West, whom I had been prejudiced against, thinking him a quack from what I had heard of him. I found him a very intelligent, smart, kind-hearted man. He assured me that he had dehorned many thousands of cattle. He is fully convinced, as are his neighbors who have seen and become acquainted with the operation, that it is, on the whole, a humane practice. It saves more in the direction of injuries that might occur afterwards, ten times or a hundred times over, than the momentary pain occasioned by the operation.

Secretary **Gold.** "What is the best way to save seed corn?"

Mr. ———. When I see an ear that suits me, that grows near the ground, that is fully developed, when I pick it I leave it out of the bin, and when I get time I tie those ears together and hang them up by the husks. It is worth to me all it costs to look at it, and then I know where it is.

Mr. ———. I think corn ought not to be dried too much. Corn that is hung up and subjected to too much heat is very apt not to come; but corn that is cured in a well-ventilated bin, without any mold and without any heat, in my opinion is almost sure to come; and if a man has good judgment in the selection of ears he will get better seed-corn in that way than he can in any other.

Mr. **Lee.** I pursue very much the same course, but about this time of the year I take my seed-corn from the husk and put it into tight flour-barrels. I have had, in one or two instances, my corn injured by hanging through the winter, and for that reason I take it down and put it into barrels. Such corn has always done well for me.

Secretary **Gold**. This subject was up for discussion last year and was debated very extensively, and, as the result of experiments carefully conducted by Dr. Sturtevant, it appeared that the corn should be thoroughly dried in a warm atmosphere, and that there was no better place than near a kitchen stove. The statement of Dr. Sturtevant was that corn thoroughly dried in that way was sure to germinate, and that it germinated well. That seemed to agree with my somewhat irregular practice, but in view of the suggestions there made I have prepared a rack in the upper part of a room where there is a fire continuously at this season, on which I placed my seed corn for the next year as soon as it was taken from the stalk and partially dried, and I have concluded to let it remain there during the winter. I am not sure about the expediency of packing it in barrels.

Mr. **Fenn**. It must be thoroughly dried.

Mr. **Gold**. Tell us how you do it.

Mr. **Fenn**. I put it on racks. This year I discarded the floor. It is almost impossible in cold weather to dry seed-corn properly upon a floor, especially if it is a hard oak floor, as the floors are in my building. Consequently I have put up racks, four or five in number, perhaps twenty inches apart, using four, five, and six-inch strips of board, leaving a space as large as possible and not allow the corn to drop through, giving a thorough draught of air all the time, when the weather is suitable for having the doors or windows open. This year I have procured a large sheet-iron stove in which we burn the cobs, and during the damp days that we have had this fall we have kept a fire in that stove to remove the dampness which accumulates over night, so as to keep it drying all the time. We leave it in that condition as long as we possibly can before it is called for by the planters.

Secretary **Gold**. What should you suppose would be the effect of putting this dry corn into barrels?

Mr. **Fenn**. When the cob is thoroughly dried it will do to pack in barrels. It will not do to allow the barrels to remain headed up for any great length of time. I remember an instance where a man packed some corn which he supposed to be thoroughly dry into barrels, and put it up in a loft which he considered very dry, but when he came to unhead the barrels he found that the corn had absorbed moisture, and a great deal of it was spoiled.

Mr. ———. I do not head up my barrels; I leave sufficient space for air, but cover them enough to keep out the rats.

Mr. MYRICK. Before we proceed to another question I want to say a word about dehorning. I was sorry my friend Mr. Cheever did not bring out a point in Mr. Hoff's experience. He was quite early in his career arrested in Illinois for cruelty to animals. The trial was a very famous one, and was attended by farmers from far and wide. The result was that he was acquitted, the court deciding, after a large amount of evidence had been submitted, that the process was not a cruel one. From all the observation that I have made in the West I believe that dehorning is one of the things to which we ought to pay attention. It is certainly having a very great run all through the Western States, where they keep large numbers of cattle, and it is indorsed by some of the best practical as well as the best scientific men of that section. Speaking of this matter reminds me that my friend Mr. Brooks of Princeton, Mass., dehorned a bull and some other young creatures. He is a member of the society with a long name, and the president of that society wrote up to him and said, "Mr. Brooks, I hear that you have been sawing off the horns of your bulls; that is a very cruel thing to do, and will you please explain?" Mr. Brooks, who is an independent old farmer, worth about half a million dollars, wrote back and invited the president up to his place. He said, "If you will please come up to my farm I will turn you into a pen with a bull that has got his horns on, and after that experience if you don't come out in favor of dehorning, then I will never take the horns off of another creature." (Laughter and applause.)

Mr. EDWIN HOYT. I wish to say a few words on this subject; not that we have had so much experience in dehorning as we have in raising cattle without any horns. Dehorning may be a good thing temporarily, but it will not ensure calves without any horns, and we have got to go through the process every time we have a calf. Now, we are breeding animals without any horns, and I tell you it is a pleasure to have a herd of that kind. You can herd them in your yard like sheep. You never see one of them gored or afraid of another. I have seen eight or ten come into a small pen not fifteen feet square, and they are as docile and kind as so many sheep. We have bred them now to that extent that all our calves are without any horns, and we are not under the painful necessity of dehorning them.

Mr. MYRICK. It is surprising how quickly you can take the horns off of a creature. I saw sixteen two-year-old steers dehorned in Wisconsin, I was going to say in eight minutes, but it was a very short time.

Secretary GOLD. Mr. Hale is called upon to give his experience with regard to the Ross peach, and also as to the best peaches.

Mr. HALE. The best peach for eating, I should say, is the Mountain Rose, which ripens here the very last of August; then the old Mixon Free, and then the genuine Morris White, if you can get it. Those are the three best peaches I know of to eat. We had quite an abundant crop of the Pratt Seedling this year. Most of our trees were so overloaded that we picked off a large quantity of the fruit when it was a little larger than hickory nuts, but still we did not thin it enough, and a good deal of the fruit was small. From a few of the trees that were thoroughly thinned, so that we picked perhaps three or four baskets from a four or five-year-old tree, the fruit was very handsome, large, yellow, with red on the sunny side. I do not consider it as good a peach in quality as the Early Crawford; it is very much better than the Late Crawford, but, having a small pit, it is one of the most economical peaches for canning. The great value of that peach is that you can plant the pit and it will reproduce itself.

In regard to value in our market, there is no peach that sells as well as the Late Crawford, but as far as my experience goes on my own farm, there is no peach that is so unreliable here in Connecticut as the Late Crawford. The tree is tender, it will suffer from extreme cold in winter when other varieties will not be affected, and even if the tree lives through the winter the buds are more tender than other varieties right alongside. Where Stump the World, Old Mixon, and Mountain Rose will carry through enough buds for an abundant crop, the Late Crawford will have very few living buds. I should plant the Stump the World, the Old Mixon, and the Mountain Rose; they are all reliable peaches. There is one other peach that I would plant before all others, and that is the old Smock peach. It is not called a good table peach, but it is a very valuable peach for canning purposes, and for five years, when we have failed to get any fruit from any other tree, there has not been a year when we have not had some fruit from the Smock trees.

Mr. JEFFRIES. Is not that peach possessed of better keeping qualities than any other?

Mr. HALE. It will keep three times as long as you can keep the Old Mixon. I might add, for fear of leading any one astray, that it is a little bit late for our climate; some seasons it will not mature. That is the one objection to it.

Secretary GOLD. "Can peaches be planted safely where grown before?"

Mr. HALE. Yes, sir.

Mr. MEECH. I think it would be unwise to replant in the same spot where the previous tree had stood. I am very happy to indorse the selection of friend Hale as to the best peach. The Mountain Rose is the best peach that grows.

Secretary GOLD. "Has any one a right to remove earth in front of one man's place to improve the front of another?"

Mr. HALE. I suppose that means to improve the highway in front of another?

Sec. GOLD. It does not say so. Taking the question literally, I must answer no. I believe the surveyors have a right to take the earth in front of one man's place to fill up the highway in front of another's, but not to improve any man's private grounds.

The next question is: "How shall we ripen winter pears?" These Anjous before you, in their perfection of form, beauty of skin, and lusciousness of quality, prove that somebody knows how to ripen winter pears.

Mr. Fenn. A few years ago I was shown, by a commission dealer in New York, some pears, I think of that same variety, which were picked just at the proper time, placed in cold storage, and he had them there for sale. They were certainly put up in the finest shape and were the handsomest looking pears that I ever saw in the market. He said they were put into the baskets and put into cold storage, and when the man intended to ship them to market he sorted them over and selected such as he wished to send away, and arranged them in the shape in which I have mentioned. He simply said they were put into those baskets and placed in cold storage. He did not go into details any further.

Mr. Coe. I have grown pears for several years. I have had as many as 1,500 bushels some years. I have kept them in cold storage. The Anjou is not a winter pear. The proper season of the Anjou is in November and December. Those pears were of course kept in cold storage. The only secret about ripening winter pears is to keep them where they will not dry. If kept in a large mass in a barrel they will not evaporate, they will ripen. In cold storage the Anjou will ripen just according to the temperature it is thought best to keep it in. If kept moderately cold, they will keep until December. I was lately in a commission-house where I saw some Easter Beurres that were bringing five dollars a bushel. But in Connecticut we cannot grow pears of that texture, because there is some kind of fungus which attacks our pears and discolors their skin. I was told in New York that there are no Connecticut pears that are so fair as those grown in Central New York and in Massachusetts. There is some peculiarity in our climate which causes the growth of a fungus which attacks the skin. I have sold pears at eight dollars a bushel, but that was before the California competition became so severe. I have sold Anjous at six dollars a bushel.

Mr. **Whittlesey**. I will ask the gentleman what those of us who have not cold storage shall do with our pears?

Mr. **Coe**. Put them in the coldest place you can and not freeze. It is a good plan to put them in a cellar, and open the doors at night. Put them in some place where you can protect them from currents of air during the day, and open the doors at night.

Mr. **Hale**. If your cellar is a damp one, so much the better. A dry cellar is not so good as a damp one.

Sec. **Gold**. Pears thus preserved want to be brought into a warm room for a greater or less length of time before they are wanted for use, according to the variety and the degree of maturity to which they may have attained, in order that they may ripen to the full perfection of flavor and quality that belongs to the variety. If they are kept continually in cold storage they will rarely attain the perfection that they will if brought into a warmer atmosphere at about the proper time.

Mr. **Coe**. The Anjou will stand any amount of cold short of freezing. But there are a good many that will be spoiled by cold storage, the Bartlett, for instance. What little flavor it has will go in a few weeks.

Mr. **Platt**. Will apples keep best in a damp place?

Sec. **Gold**. There is no doubt that apples must be kept in a reasonably damp place. In fact, it has been testified that in cold storage the water dripping from the ice and falling upon boxes of fruit has not injured it.

Mr. **Platt**. Will they keep better in boxes or barrels, or simply in open bins?

Mr. **Coe**. It does not make a particle of difference. They ought to be where they can have some air. If you shut them up too closely they are more liable to mildew. If you put them in a dry place they will dry up. I have about 5,000 barrels of apples in cold storage, and they are all in the bins.

Adjourned to evening.

## EVENING SESSION.

The Convention was called to order by the Secretary at 7.45, and the Question-Box was once more opened.

Sec. **Gold.** "Will horses be healthy kept in a stable with pigs under them?"

Mr. ———. Yes, sir.

Sec. **Gold.** "Is it healthy for horses to breathe the same air that cows do?"

Mr. ———. No, sir.

Mr. ———. Give them plenty of air, well ventilated.

Sec. **Gold.** "What is the best system of ventilation for a basement cow stable?"

Mr. ———. Plenty of outside air.

Mr. ———. Remove the foul air overhead.

Mr. ———. My cows are stanchioned in a stable that has been used for sixty years. It is kept clean, and there is good, sweet, wholesome air there.

**Question.** How do you introduce fresh air?

Mr. ———. I have windows on one side, by which I can ventilate it.

Sec. **Gold.** "What is the cure for worms in horses?"

Mr. ———. Potatoes.

Mr. ———. Rock salt in the manger.

Sec. **Gold.** "Is it profitable to top-dress grass land?" There are thousands of acres of land in the State that are of very good surface for mowing, that cannot be plowed. The only means of sustaining their fertility is by top-dressing, and that fertility has been maintained for a hundred years or more upon many of those fields by that system.

Mr. **Myrick.** What artificial fertilizers are the best for top-dressing? I do not mean manufactured fertilizer, but is there anything better than bone and ashes?

Sec. **Gold.** You will have to ask some of those who rely upon commercial fertilizers. Is there anything better, Mr. Bill, than leached ashes?

Mr. **Bill.** That question ought not to be put to Mr. Bill, as Mr. Bill sells ashes, and it would be puffing up his own wares. However, Mr. President, I will say, in relation to the inquiry made of me, that I am unable to say. I have never used a pound of commercial fertilizer, and if I live seventy years longer I never shall. I have used ashes at the rate of five or six thousand bushels a year, in every shape, and I consider them a good fertilizer, to say the least.

QUESTION. Do you always use leached ashes? The *Homestead* says that unleached ashes are much better than leached ashes.

Mr. BILL. I at an early day used leached and unleached ashes side by side, to see if my father handed down to me the right idea of the thing. I heard him say, when I was a boy, that he had used leached and unleached ashes side by side, and that he always gave his preference to the leached ashes; that the unleached took hold quicker, but the result in the end was better with the leached ashes, from the fact that he got so much more for the same amount of money, and there was only one portion of the value of those ashes extracted, which was the potash, and all the other ingredients were increased in proportion as the quantity of ashes was increased; therefore, as he contended, the leached ashes were the more valuable. It was for my interest to know for myself, and I have, upon many occasions, tried experiments in the same way; and I have found that the leached ashes, on account of our being able to get so much greater quantity for the same amount of money, were the best.

Mr. HALE. For a substantial building up of the soil and a continued grass crop, I should say an application of three parts bone to one of muriate of potash, using as much as you can afford, would build up your grass land permanently. If I wanted to get as much grass as possible from a piece of land for a few years, I would use nitrate of soda, say a hundred pounds to the acre, after the grass got well started in the spring. This application will develop the grass crop wonderfully on any field I have ever seen. The grass will show it in its color in forty-eight hours, and in its growth in three or four days.

Sec. GOLD. "What is good for a horse that scours when driven on the road, but is not troubled with the complaint at other times?"

Dr. CRESSY. Mild astringents.

Sec. GOLD. "What kind of corn is the best to raise in Connecticut?"

Mr. ———. Sweet corn, for family use.

Sec. GOLD. That depends. Connecticut, with its small territory, has the capacity to raise, and does raise, probably, a greater variety of corn than any other State in the Union, unless it be the State of New York. Along our coast line we raise dent corns that will compare in size and yield with the richest fields of the West; through the valleys of the Connecticut and the Housatonic, the larger varieties of flint corn are at home, and mature perfectly their large, long ears; and upon the lighter soils in some parts of the State, the shorter ears of the top-over, and other varieties of that kind, are preferred by the farmers. Now, we have modes of culture adapted to all these kinds, and it is as difficult to answer that question as it has been to answer the question "what is the best potato?"

The next question is: "Is there any cure for the peach yellows?"

Mr. MEECH. Yes, sir; the grub hoe. That is what I use.

Mr. HALE. Close pruning, and a very liberal application of muriate of potash.

QUESTION. What is the application per tree or per acre?

Mr. HALE. From twelve to twenty pounds to a tree that has the yellows; ordinarily, not more than two or three pounds to a healthy growing tree. I would apply that when I saw it was needful. I believe that would be enough; but I would continue to apply potash every year to those trees. I believe that one application would drive off every trace of the yellows unless the tree was nearly gone. The pruning should be done in the fall.

Sec. **Gold.** I hope Mr. Hale will have no occasion to lose his faith in a remedy for the yellows.

"What food ration best supplies the need of a colt during the first winter of his life?"

Dr. **Bowen.** Potatoes, apples, and oats, in reasonable quantities, will keep a colt in thriving condition, in addition to hay. You will all agree with me, perhaps, that if there is any period in an animal's life when it needs an abundance of suitable material to keep it in a healthy growing condition, it is during the early years of its life. I have had a little experience in raising colts, and have always practiced in that way, feeding something to keep the bowels in good condition, potatoes or apples in small quantities, with perhaps a quart of oats a day. That, with good hay, will keep a colt in a very thrifty condition.

Sec. **Gold.** "Why is farming such poor business, when everything we eat, drink, or wear, directly or indirectly, comes out of the ground?"

Did not Mrs. Virginia T. Smith answer that question, yesterday, when she dropped the remark incidentally that farmers sometimes were "shiftless"? (Laughter and applause.)

Dr. **Bowen.** For the reason that too many farmers plow the road instead of the field.

Mr. **Bill.** I take the ground that farming is not a poor business, but it is a first-rate business; that if the farmer would live as he should live, in proportion to his income, there is as much to be made out of farming to-day as there is out of any other branch of business where the same amount of capital is invested. I believe that is the true idea, and I think that the object of such a convention as this should be to advocate that theory. I believe that if a farmer would live to-day as he lived prior to the war, before he and his family drifted into these expensive habits of dress and of food, he would make the same amount of money that he made in those days. When I was a boy, the farmers all made money, and the prices that they received for their crops were nothing like what they receive to-day. I tell you we have gone in the wrong direction. During the war money came so easy to the farmers that they acquired habits of luxury, which they think they must keep up when the prices which they receive for their products are very much less. Now, if we would go back to those economical habits in dress and food, if we did not lay out so much upon our families in various ways, we could make as much out of our farming operations as we made in those days. I say farming is a first-class business for the amount of money which is invested to carry it on, and I repeat what I have said, that it should be the object of this Convention to advocate, what I believe is true, that it is profitable to carry on farming in this State to-day, if it is carried on rightly. (Applause.)

Sec. **Gold.** "How can we raise pears like those on the platform?"

Gov. **Hyde.** Raise them at Rochester.

Sec. **Gold.** That seemed to be the decision of one of our pear experts, to-day, that our climate did not admit of that perfection of skin and color that we find in some of the Western fruit.

"What is the office of the honey-bee in nature?"

Mr. **Jeffries.** Some of our most valuable flowers would become extinct were it not for the honey-bees that carry the pollen from one flower to another, so that the species is perpetuated.

Mr. **Whittlesey.** If you put a fine wire net over a bunch of red clover it will grow, but there will be no seeds; and so, also, of the white clover. If the bumble-bee does not have access from one plant to another, there will be no seeds in the heads of clover.

Sec. **Gold.** Gentlemen, the Question-Box has been emptied.

The quartette then gratified the Convention by singing another song, which was loudly applauded.

(Vice-President Day in the chair.)

The **Chairman.** Ladies and gentlemen, it has been my pleasure to have known the Secretary of your Board for more than thirty years, and I must bear testimony to the fertility of his brain in furnishing for a long, long period such splendid agricultural food as he has furnished for the citizens of the State of Connecticut. We could not close up our exercises without an address from one of the ladies, and with his usual thoughtfulness he has reserved one of the best speakers for the last. I take great pleasure in introducing to you Miss **Frances E. Burr** of this city.

## THOUGHTS AGRICULTURALWISE AND OTHERWISE; OR TWO KINDS OF CULTIVATION.

*Gentlemen and Ladies:—*

When your secretary invited me to address you, I thought: "I can never do that, since they know all about agriculture, or are supposed to, at least, while I know nothing about it." But as he gave me considerable latitude in the selection of topics I concluded I might make the attempt. Moreover, on reflection, I concluded that if you wanted a scientific talk on agriculture, or even a talk on agriculture, leaving the scientific out, he would never have come to me, but would have selected an expert on the subject. Furthermore, as I come at the close of a three-days' convention devoted to agricultural topics, it is to be implied that you need a little relaxation, or change. Change is rest; but I hope I shall not prove such a complete rest as to put you all to sleep. So I come to you a layman, or laywoman, to talk to you, a solid body of farmers, men and women, —on what? Not to give a dissertation on the analysis of soils, nor to tell the best kind for particular crops, for I should get my foot into the soil pretty deep, and have these farmers laughing in their sleeves, or worse yet, outright. Not to go into the philosophy of fertilizers, and the per cent. of salts of potash they contain, for I might get smelling salts, Glauber's salts, table salts, and potash salts somewhat mixed. Not to go into the merits of ensilage and silos, for it would be pretty dry fodder before I got through with it. Not to tell the best mode of irrigation, though I might, perhaps, have an idea on that subject. So you see that these, and all other subjects that a farmer is naturally supposed to be interested in, are all Greek to me. There are the pigs and cattle, cows and horses, sheep and poultry; the architecture of barns and piggeries, henneries, etc.,—all prolific in interest when rightly handled, to say nothing of the supremely important subjects of ventilation and drainage, and the subject of pure water for man and beast. And so I might go all over the agricultural field in vain for a topic upon which I could talk intelligently. But as the world of things I do not know is so vast and discouraging, I will drop the unpleasant subject.

Horace Greeley once advised young men to go west instead of settling down and cultivating New England soil. Doubtless his recollections of his father's farm were not the most cheerful, for Zaccheus Greeley had to wrestle with the rocks of New Hampshire without the aid of the modern inventions and discoveries that have come to bless the farmer of our day. Horace Greeley was born among the hills of old New Hampshire, whose most prolific crop is granite. But New Hampshire, like other New England States, has a habit of turning out characters of granite, and Horace Greeley was not an exception. He has gone down into history with his whining, nasal twang, and his old white coat stuffed with newspapers, as a character wholly unique; a typical Yankee. He was born an editor and not a farmer, nor for the presidency, though that bee got into his bonnet and stung away his wits. When he advised young men to go west he had probably forgotten, if he had ever thought of it at all, that all men were not like him, unfitted for farming, and especially New England farming. If they had all followed his advice I'm afraid our New England farms would by this time have become a thing of the past. What would New England be without her farms? Where should we look for our strong men and women — strong not only physically, but mentally? For New England farms turn out something better than corn and potatoes, oats and rye, pigs and cattle. Our most sterling men and women trace their lineage back to the old New England farm. The very bleakness of the climate and the rocky soil create characters of enterprise, endurance, and sterling worth; characters with a background and foundation as strong and firm as her rock-ribbed hills. Go to the tropics and to climates where nature turns out her products in profusion, with little or no assistance from man, and you will find characters in which the sturdy enterprise of our own land is lacking; has never been developed. How large a proportion of our country's most noteworthy characters were the product — either directly or remotely — of New England and New England farms, is a question that almost answers itself. The boys and girls brought up on a farm have a thousand clustering reminiscences that the city-bred boy and girl never dream of. And it is a loss to the latter none the less for their being ignorant of them. Who ever forgets the old farm house, swept by the storms of many winters, and made glad by the suns of many summers? Who ever forgets the "old oaken bucket," and the old well-sweep now fast going out of existence? Who ever forgets the old hay-mow in the barn, and the old barn itself and its rookeries? Who ever forgets the old fields with their belated strawberries? Who ever forgets the waving grain and the rustling corn-fields, and the yellow pumpkins, and the husking-bees, and the songs of "Harvest Home," and the harvest moon riding overhead? Who ever forgets the old orchard and its luscious apples that never again tasted so sweet as they did in that early morning of life before the peach-bloom of youth had faded? Who ever forgets the old school-house, cold in winter and hot in summer, and its benches notched by the knife of many an aspiring lad, who began thus early to carve his way, perhaps to the presidency of the United States?

Who ever forgets the old country church with its high-backed pews and its high-up prison-like pulpit, where the old-time pastor preached his long and prosy sermons, and to sit under which without going to sleep was one of the virtues instilled into the young and plastic mind? Who ever forgets the pungent scent of fennel-seed or dill, carried by the good dames by way of refreshment, and for the commendable purpose of helping them keep awake? Who ever forgets the old church choir, and each individual singer thereof? On that point I will let Benjamin F. Taylor do the subject justice:

"It was the sweet old 'Corinth' they were singing,— strains we have seldom heard since the rose-color of life was blanched; and we were in a moment back again in the old village church, and it was a summer afternoon, and the yellow sunbeams were streaming through the west windows, and the silvery hair of the old deacon who sat in the pulpit, was turned to gold in its light; and the minister, who, we used to think, could never die, so good was he, had concluded 'application' and 'exhortation,' and the village choir were singing the last hymn, and the tune was 'Corinth.' It is years — we dare not think how many — since then, and the 'prayers of David the son of Jesse are ended,' and the choir are scattered and gone. The girl with blue eyes that sang alto, and the girl with black eyes that sang air, — the eyes of one like a clear June heaven at noon; those of the other like the same heaven at night. They both became wives and mothers, and both died. Who shall say they are not singing 'Corinth' still, where Sabbaths never wane and congregations ne'er break up? There they sat, Sabbath after Sabbath, by the square column at the right of the 'leader,' and to our young eyes they were passing beautiful, and to our young ears, their tones were 'the very soul of music.' That column bears still their penciled names as they wrote them in those days in life's June, 18—, before time had dimmed their spirits like a summer cloud. . . . What would you and I not give for some stethoscope of the soul whereby we might hear the music of the heart, and the foot-fall of thought in the hall of the spirit! Such utterances we do sometimes hear, and music is the melodious wing that wafts and warms them on their mission round the world; that will not let them die. Auld Lang Syne, here it is, glittering with the dews of its native heather; sung last night in a hovel; sung this morning in a hall. 'When shall we meet again?' Since those old years went by, how many lips have asked, how many knells have answered it! Where pipes Cape Horn through frozen shrouds, the mariner hums 'Sweet Home' to-night; where hearts are desolate and cold, they sing 'Sweet Home' in Heaven. With how many blended hearts from Plymouth to the prairie, Dundee's wild warbling measures rose, those long-gone Sabbath morns — the strain the Covenanters sang two hundred years ago,— the tune that lingers yet along the banks of murmuring Ayr. 'Those Evening Bells,' and 'Sweet Afton,' and all that long array of sweet and simple melodies that linger round the heart like childhood's dreams of heaven; whence came their breath of immortality, if not from lips of Eld? And then those sacred tunes that floated round the old gray walls of the village church and haunt our memories yet! St. Martin's, St. Thomas, and St. Mary's, immortal as the calendar. Old Hundred, Silver Street, and Mear, and sweet old Corinth; Denmark, Wells, and Peterboro, chance breaths caught from the choir above. The faces of the singers have changed since then. Those plaintive airs they sang around the open grave beneath the maple's or the poplar's shade! Lay your hand upon your heart and tell me what is nearer to them than those old strains? There's Tallis's Evening Hymn, the vesper of two hundred years! They sing it yet; sing it as *they* sang in twilight's hush and charmed our youthful ears. *They?* Who, and where are *they?* The loved in Heaven. Perhaps they sing it there. Who will not say with Christopher North, 'Blessed be the memory of old songs forever!'"

Judging from the above quotation, Mr. Taylor must have been a New England farmer boy. His words come from the heart. New England! The very name has a charm to the ears of her children. The Pilgrim fathers — and the Pilgrim mothers — who does not revere their memory? In the Rotunda of the Capitol at Washington is a painting that somehow I always liked to look at. It is a painting by Weir of the Embarkation of the Pilgrims at Delft-Haven, Holland, July 21, (O. S.) 1620 In that little band embarking on the Speedwell, the eye seeks out the prominent ones: Elder William Brewster; Mrs. Brewster; Gov. Carver; William Bradford; Mr. and Mrs. Winslow; William Robinson. the pastor of the flock, but who remained behind. And last, but by no means least, sturdy Miles Standish and his pretty wife Rose.

We love to follow this group which afterwards sailed from Plymouth on the Mayflower, and which has become classic,— a New England classic of hardy growth, destined to a fame immortal as that of old Greece and Rome, enduring as New England's granite hills. We love to follow that little band, launched on a summer sea, but by delays and tedious voyaging running into winter seas and storms, and landing on a rocky shore where they had to contend with a climate as inhospitable as the savages who had preempted the land. Bleak? Can anything be bleaker than the background of that winter picture? Wild winds and wild waves, wild rocks and wild caves; wild men and wild beasts — a wilderness of wildness. And were they not wild themselves to come? No. There is something sublime in the stern, unbending faith of those old Puritans. The climate to which they came was not sterner. The rocks on which they landed would yield beneath their feet sooner than they would yield one iota of their faith. But we cannot overlook the fact that the Pilgrims were human like the rest of us. and that with all their virtues and heroism they were a little bit intolerant. Some one has wittily said: "They came for freedom to worship in their own way and to compel others to worship as they did." But that was the legitimate outcome of the austere thought of the day. They resisted persecution as we would have done, and as did the old Scotch Covenanters in their stalwart stand against the liturgy King James imposed upon them. The old Nonconformists, Puritans, or Roundheads, as they were variously called, were the foster parents of our Pilgrim ancestors, and it is not strange that in their resistance to religious persecution they should have imbibed and applied a little of this persecution to the Quakers and some others who differed with them after they had successfully established their own mode of worship in this new land. For thus it is that so little apt are human authorities to temper justice with mercy, religion with reason. But we glory in our Puritan ancestry. We want them to be just what they were with all their faults. A person who never committed a blunder — supposing there could be such a one — would not be good for much. Blunders are the steps by which we rise to something better. The Pilgrims worked in the direction of freedom, though they naturally had to work under the limitations and austerities of the thought of that day. Tolerance is a plant of slow growth. It comes up through storms, persecution, and adversity. The Pilgrims preferred to battle with savages and a hostile climate to battling with intolerance at home, so they came here and planted their faith, drawing the lines around it a little taut, to use a nautical term, but maintaining their right to worship according to that faith with a sturdy heroism that has commanded the admiration of the world. They dotted the hill-sides and vales of New England with their little churches and school-houses. They laid out the bounds of their farms, and built their farm-houses, and struggled with the rocky soil and made it respond with harvests. And this brings me back to my point, for I have not forgotten, my friends, that I am talking to an agricultural convention, though I did forget to announce my text, or my topic, and that is, "Thoughts Agriculturalwise and Otherwise, or Two Kinds of Cultivation," — cultivation of the soil and cultivation of the mind. For a man can plant potatoes or hoe corn, and plant ideas in his mind at the same time. In going back to our Pilgrim farmers, as well as Pilgrim fathers, I could but think how much better they builded than they knew, for in fighting for toleration for themselves they planted the seeds of a mighty harvest, which is still springing up, and will not cease. Surely our thanks are due to the kings and queens and potentates of various descriptions, both Catholic and Protestant, for their intolerance which drove our good forefathers and foremothers to this land. Little did they dream of the vast nation that was to rise in this new world, and to the dominating characteristics of which the early colonists of New England certainly gave shape and mental impetus. Could they have looked forward 250 years and seen the vast changes that those years have developed; the wonderful discoveries and inventions; the utilization of steam and electricity for swift voyaging and swift communication, thus bringing the nations together and realizing the prophecy of the fairy Puck: "I'll put a girdle round about the earth in forty minutes";—the wonderful growth of ideas keeping even pace with the discoveries, or the discoveries keeping even pace with the growth of ideas;—could they have had a prophetic vision of all this they would, no doubt, have turned in bewilderment to their rural homes and asked to be allowed to die in peace, for their minds were not adapted to the rush and whirl of life and brain in this electric age. They were satisfied with cultivating their little farms and cultivating their faith in the minds of their children. This was what they came for. But it was not to stop there, for the whirling ages never rest. As the sun rises in the east and hastens to his setting in the west with untiring precision, so the ages move on and never stop, and people have to move with them whether they will or not. Each step in the world's evolution is the result of a previous step. We can trace backward our progress, step by step, through the pages of history, pointing to landmarks, or to movements here and there, which sent us on with swifter speed. By "we" I mean the human family that runs back into the mists of the past, and that is to run forward into the mists of the future, for we are placed here between two eternities, the cradle and the grave, both of them wrapped in mystery, for we know as little of the life that preceded our advent here as we do of that which awaits us. Every event in the world's history has had its appointed result, and has helped to place us just where we are to-day, though some events, of course, have been far wider-sweeping than others. Where should we be to-day in point of progress had it not been for Gutenberg's little wooden type which he invented and tied together with a string, 450 years ago? Before that, knowledge was kept from the people;

it was locked up in cloisters to which monks and priests held the keys. The costly illuminated books, the laborious work of the pen, were chained to pillars and posts lest some one should make off with them. Moreover the priests and the authorities were not in favor of having the people enlightened, and especially of reading the Bible in their own way without interpretation and explanation from ecclesiastical authorities. When the good Dr Faust. Gutenberg's associate, showed the first printed Bible, the authorities had him arrested as a magician, and for being in league with Satan and the black art. One never wearies of reading of Gutenberg's slow progress, as, step by step, he worked his way up to his wonderful invention, or discovery, of movable type,— a discovery that was to lead to the modern press and to the redemption of the world from darkness.

But to return to our sheep, as the French say, a saying that is particularly *apropos* here. I suppose every one has a sort of general idea of agriculture and farming, even though not brought up on a farm. A genuine farmer is one of the most independent beings in the world. He is free from the wrangle of politics; free from the hunt after office and the spoils thereof; free from the fever of Wall street and its crazy speculations; free from the temptations of bank cashiers, insurance officers, and the officers of other moneyed institutions, with their long lists of defalcations; free from the excitements, and too often the snarls and jangles of the bustling cities; free from the thousand worries of such life where the one ambition seems to express itself in the mad race for the almighty dollar. I have often pictured in my mind the blissful peace and rest one could enjoy far removed from all these scenes to the cozy ingle-side of some old farm-house with its crackling logs. And with the winds and storms of our bleak winters howling outside, lending an added zest to the comforts inside, surrounded by genial friends and books, to say nothing of tempting fruits from well-filled cellars, and "the bowl of samp and milk by homespun beauty poured,"—with all these accessories of a peaceful rural retreat one might snap one's fingers at the cares and turmoil that madden men's brains on the great sea of unrest. where they ride one moment on the top billow of success only to be stranded the next with the wrecks that strew the shores of despair. Compared to such a life, the rural retreat is a haven of rest indeed, where one can sleep the sleep of the blest.

I referred a while ago to the importance of pure water. There is nothing more important for town or country. And it is a source of satisfaction to know that a system has at last been perfected by which people may obtain pure water, a system that is called the Hyatt Pure Water System — a mode of filtering that is claimed to take out even the germs of disease. Of course where there are no water-works to distribute the water, this system is not available. But the Hyatt household filter. the Pasteur, and the Gate City, are three filters claimed to furnish the purest water on a smaller scale. "The Sanitary Era," a modest little publication in New York, has written up all these filters. The larger filter or system for purifying the water used by a community, is now in use by some twenty five towns and cities, and the number is increasing. One of the important points in this system is the perfect cleansing of the filter bed every day, leaving the sand and other filtering materials as pure as they were before any impurities were carried into them. One of the finest tests of the thorough work done by this system of filtering was shown last summer when an oil pipe belonging to the "Tidewater Pipe Company" burst near a place known as Vanderveer's Mills, in Somerset County, New Jersey, the crude oil running down into the north branch of the Raritan river in great quantities. Subsequently, the heavy rains caused a rise in the river which deluged the lowlands and ruined the crops of the farmers for ten miles along the main river and its branch. The damage to crops by this deluge of oil in the river extended five miles below Raritan itself. At the Raritan Water Works this foul water went into the great filters and came out as sweet and pure as mountain spring water. The people in the houses where the water was taken never had a suggestion from the water itself of the impurities from which the filters had renovated it. The city of Reading, Pa.. sent a deputation from their Board of Health and Water Commissioners, together with their chemist, to the Raritan and Somerville Waterworks at the time the river was covered with a thick coat of oil, and they went home enthusiastic in praise of the Hyatt Pure Water System. Back numbers of the Sanitary Era give full accounts of this system, and the principles upon which it is worked.

My friend the horse, and also the cow, would like to come in here for a word. In their behalf, I would say that I hope the barn of the future will never have even a suggestion of the old narrow stall, dark and unventilated, and so narrow that neither horse nor cow can turn around in it. These animals need the light of heaven as well as the air, and a good square room in which to enjoy both air and light. They need these things as much as human beings. In my opinion, the horse is the noblest animal the Almighty ever made. The best breed of dogs may come up to it in intelligence,— some claim they are superior. But a horse of fine quality, with no drop of vicious blood, and whose gentle breeding is expressed in its soft and beautiful eye, has more soul, character, and nobility, than many human beings. The man who can abuse such an animal, or any animal, for that matter, should be given at least ten years in the penitentiary, The horse's chance of future probation are far superior to his. The Arabs know how to treat horses. They talk to them and treat them like human beings, and the horse responds and becomes almost human. The following little story, handed down from the past, is an instance of this attachment of the Arab for his horse :

" The whole stock of a poor Arabian of the desert consisted of a beautiful mare. The French consul at Säid, in Upper Egypt, offered to purchase her for his master, the king of France The Arab hesitated for a long time, but pressed by want, he at length consented to sell her for a considerable sum of money. The consul, not choosing to give so high a price without instruction, wrote to France for permission to make the purchase. Louis the Fourteenth gave orders to pay the money, and the consul sent notice thereof to the Arab, who soon made his appearance mounted on his beautiful horse, and the gold he had demanded as her price was paid down to him. The Arab dismounted and looked at the money ; then turning his eyes to his horse he sighed, and thus addressed her : 'To whom am I going to yield thee up? To Europeans, who will tie thee close, who will beat thee, who will render thee miserable. Remain with me, my beauty, my darling, my jewel, and rejoice the hearts of my children.' As he said this he sprang upon her back and galloped off to the desert." To him, a crust on the desert, with his horse, was better than all the king's gold without her. Such friendship is in beautiful contrast to the accounts of abuse that are from time to time brought out. They who remember the disease that struck down so many horses a dozen or fifteen years ago, will remember what a scene of desolation that was, with hardly a horse to be seen in the streets. Funeral processions went drawn by cattle, and the incongruousness of the sight was something that cannot be expressed in words. There were other mourners than those in the strange processions. There was one universal lament for the horse. All hearts cried : "A horse ! A horse ! my kingdom for a horse !" The horse was never so well appreciated as then. His services to man can hardly be over estimated, and I was glad when some kind-hearted person during the past year took the trouble to write a series of articles on the use of the check-rein and its cruelty, and also on that of blinders. I also felt like thanking Mr. Henry Bergh for sending in a protest on the cruelty of shearing horses in cold weather,— the time nature furnishes them with an overcoat they can ill afford to lose. Nature understands her business, and man cannot improve upon it as a general thing.

There is one more animal I would like to introduce here, though he is not a particular favorite of mine, and that is the pig. It is related of Dr. Adam Clark, the eminent divine and commentator, who had a strong aversion to pork, that he was called upon to say grace at a dinner one day, where the principal dish was roast pig. He said: "O Lord, if thou canst bless under the Gospel what thou didst curse under the law, bless this pig." That was a blessing to the point. The old Jewish lawgivers showed level heads when they excluded the pig from their bill of fare. Let us trust the time will come when the cities will not demand him, and when the farmers will exclude him from their premises. He was never made to be eaten any more than the hyena or the hippopotamus, the flesh of either of which would be more appetizing to me than a piece of Christian pig; for since the Jews discarded him the pig may be classed as a Christian animal. But whether Christian, Jew, or Gentile, may he be suffered to retire to his native heath, wherever that may be, and no longer disturb Christian dreams by his unwholesome flesh, essentially scrofulous and disease-producing. A farm without a pig is hardly a supposable case at present, but I have faith that the time will come when the farm will know him no longer, and the human palate will have lost all relish for him. The pig is all right in his proper place, but allow me to suggest that that place is not the human stomach. I have strong faith that the time will come — though far in the future now — when this planet will have risen in the scale of life and become so far purified that such creatures can no longer be organized upon it. I hope, too, the time will come when the race shall have discarded animal food entirely. The cruelty of slaughtering animals for the purpose of eating them. is an important consideration. Another one is the effect on the human system of such a diet. And lastly, and with some, perhaps, the most weighty consideration is the economic one. Mr. Greg, in his "Enigmas of Life," says: "A given acreage of wheat will feed at least ten times as many men as the same acreage employed in growing mutton." He goes on to give his reasons. and to show the evil of converting the richest lands of the country to pasturage instead of tillage. Francis William Newman of England, brother of Cardinal Newman, in a little book on "Diet," has many weighty arguments in the same line. He says that turning lands to grazing purposes instead of tillage tends to populate cities and depopulate country towns. The great demand of cities for cattle and other flesh food makes it for the interest of the farmer to keep arable land in pasture. Where lands are devoted to grazing, there is a less demand for labor than where they are tilled. Dr. Newman says: "If the towns renounced flesh eating we should see in a single generation, even without improved land tenure, a tide of migration set the other way — from towns into the country. Rustic industry would be immensely developed. The country would then bear a great increase of population without effort, for it is certain that ordinary arable land will produce easily four times as much human food as the same land devoted to grazing."

Dr. Newman's little book, and also one by Dr. Anna Kingsford in the same line, are full of food for reflection. The arguments of the upper-class Hindoos, the Brahmins, who eat no flesh because it is cruel to make animals suffer that we may eat them. are higher and more spiritual than those from the mere economic point of view. Edwin Arnold, in his wonderful poem, "The Light of Asia," has a striking passage describing the king in his hall of offering, with the white-robed Brahmins ranged about feeding the fires on the altar for the sacrifice. The blood of bleating victims runs down and is sucked up by the sands. The priest is about to apply the knife to another, when Buddha interferes, and softly says:

> "'Let him not strike, great king!' and therewith loosed
> The victim's bonds, none staying him, so great

His presence was. Then craving leave, he spake
Of life, which all can take but none can give,
Life, which all creatures love and strive to keep,
Wonderful, dear, and pleasant unto each,
Even to the meanest; yea, a boon to all
Where pity is, for pity makes the world
Soft to the weak and noble for the strong.
Unto the dumb lips of the flock he lent
Sad, pleading words, showing how man, who prays
For mercy to the gods, is merciless."

Schubert, the German naturalist, says:

"We often see in the eyes of an animal, glimpses of a hidden secret world, as through a door, uniting the other world with this; and there frequently appears in the eyes of dying animals, uselessly slain or tortured by the hand of man, a gleam of deep self-consciousness, which is prepared to bear witness against us in the other world."

Bryant, in one of his fine poems, tells us about a white-footed deer that grazed on moonlight evenings on a grassy mead near a woodland cottage. The cottage dame forbade her son to aim his rifle there, and told him how the red men said she had walked there a thousand moons ago,—

"They never raise the war whoop here,
And never twang the bow."

The youth heeded the injunction for a while, till one night he came home discouraged, having found no game. The deer, with a spotted fawn by her side, was grazing in the moonlight. The cliffs echoed back the sharp crack of his rifle, and the startled creature fled to the woods, leaving crimson drops by the way:

"Next evening shone the waxing moon
As sweetly as before;
The deer upon the grassy mead
Was seen again no more.

"But ere that crescent moon grew old,
By night the red man came
And burnt the cottage to the ground,
And slew the youth and dame."

I always had a sort of fellow-feeling for those Indians, while regretting the sacrifice of the good dame; but Indian justice does not stop for small details; it does the job on wholesale principles.

There is an old-time argument that we cannot build up brawn and muscle on a vegetarian diet. But the strongest man I have heard of in recent years was a man in New York who had never tasted meat. He weighed nearly 200 and was so strong that athletes did not care to wrestle with him. An elephant is a creature of fair proportions, and is not puny as regards strength, and the elephant is not a carnivorous animal. The gorilla can tear a good-sized tree up by the roots, and the gorilla never eats flesh. The horse and ox who never eat flesh could tear their flesh-eating master to shreds. The finest specimens of muscular strength are to be found among the peasantry of the old world, whose parents scarcely tasted meat. They were brought up on oatmeal, brown bread, barley, potatoes, etc. It is only within the last quarter of a century that they have taken to the use of flesh food, and within that time the peasantry of the rural districts have begun to degenerate. The old Greek athletes and wrestlers lived on a simple vegetable diet. "In the palmy days of Greece and Rome," says Dr. Kingsfore, "before intemperance and licentious living had robbed those kingdoms of their glory and greatness, their sons, who were not only soldiers but heroes, subsisted on simple vegetable food, rye meal, fruits and milk. The chief food of the Roman gladiators was barley cakes and oil. And this diet, says Hippocrates, is eminently fitted to give muscular strength and endurance."

We can hardly expect a cessation of wars and murder while people depend on the slaughter-house for their food. In my opinion, the anarchist's chief sources of inspiration are the flesh-pots of Egypt and the beer-pots of Germany. Was there ever an anarchist who was a vegetarian? Or a vegetarian who was an anarchist? Dr. J. C. Jackson of the Dansville (N. Y.) Sanitarium, says he will never undertake to cure a drunkard unless he can control his diet. By striking out meat entirely, he has cured many a drunkard. Baron Von Liebig, the great German chemist, says: "Entire abstinence from the use of animal food causes the desire for alcoholic stimulants to disappear."

Horticulture is, I believe, a legitimate branch of agriculture, and a delightful one. When we think of the luscious fruits this country produces — fruits that make the mouth water to think of them, and also the eyes of those who cannot get them — it would seem that the products of the slaughter-house would be at a discount, and that cattle, sheep, and swine, and the deer of the forest, and the birds of the air, would be allowed to live in peace. I was glad to read last fall of the great crop of peaches my friends, the Hale Brothers of South Glastonbury, had raised on their farm. That crop was more inspiring than the groans of the slaughter-house, and also pleasanter to think of than all the tobacco crops between Connecticut and Cuba. I do not blame any one for raising tobacco when it can be made more profitable than other crops. But I do hope the time will come when tobacco-raising will not be profitable.

I have referred to the happiness of rural life, but I suppose that that, like everything else in this mortal life, has its hitches and draw-backs, though a rural life has probably less of these than most others. Even Rasselas, Prince of Abyssinia, became wretched in his Happy Valley, where he had nothing to do but to enjoy himself, and secretly groaned to escape. That magnificent allegory, drawn by a master hand, is a true picture of human life and the workings of the human mind. When he finally escaped from the Happy Valley he found happiness as far off as ever. It was ever receding, and as difficult to catch as the phantom "Will-o'-the-Wisp." The princess, his sister, put the whole thing in a nut shell when she said: "Such is the state of life that none are happy but by the anticipation of change. The change itself is nothing. When we have made it, the next wish is to change again. The world is not yet exhausted; let me see something which I never saw before."

The moral is obvious. Happiness will not come by hunting for it. It comes when we are not seeking it, but are performing our daily tasks in the right spirit. Emerson says that no matter what our work is, if we bring the right spirit to it we shall elevate it and make it seem the most desirable of all things to do that particular work. Even the scrubbing of floors, if done with a cheery heart, will make beholders want to fall to scrubbing floors. The workman elevates his work in proportion as he puts himself into it, and makes it drudgery in proportion as he keeps himself out of it. But by putting himself into his work, I do not take it that a man is to think of nothing but the horse-shoe he is making, the potatoes he is hoeing, the grass he is mowing, etc., for thus he would stand in danger of becoming an imbecile, for the mind must have something to feed upon besides grass and potatoes. When the body has all the exercise and the mind none, reason is apt to totter, that is, if there is mind enough to totter. The two kinds of cultivation should go hand in hand. The man who sows a field of rye may, at the same time, be sowing a mental field of thought. Under such a *régime* there is no drudgery in the work, and no danger of insanity. He who merely vegetates stunts the soul. The writer of the old song, "My mind to me a kingdom is," understood the true philosophy. If he was a tiller of the soil he must have had fine crops if they kept pace with the products of his mind. Better let the garden run to weeds than the mind, for mental weeds are harder to eradicate than the weeds of the soil. Change is rest; and when the body is tired there are plenty of bright books to give refreshment, for the body can be refreshed through the mind. Farming in these days is not what it was when the Pilgrims wrestled with the rocky soil. For every bushel of potatoes they raised they had to cart off two bushels of stones; and the inventions that have come to bless the modern farmer were never dreamed of then. As to literature, aside from the Bible and the Hymn-book, they had to content themselves with the Westminster Catechism and the New England Primer, all excellent as far as they went, but the bill of mental fare was rather too limited to allow of any very prolific growth of ideas. Of course they must have had *some* books, some of the standard authors from Homer to Shakespeare. John Bunyan's immortal work had not got along. As to newspapers, they never knew what they missed. "Where ignorance is bliss, 'tis folly to be wise." And what did the children feed on? "Spiritual Milk for American Babes, Drawn from both Testaments for their Souls' Nourishment, by John Cotton." So runs the title of a little book I have, that was printed some 250 years ago. One question and answer will suffice for the whole:

Q. "What is your corrupt nature?"

A. "My corrupt nature is empty of grace, bent unto sin, and that continually."

Poor child! The heart bleeds for it. But somehow those children pulled through, and in most cases I believe they retained their wits.

The contrast between those days and the present is striking. What does the farmer not have in literature? He can bring to his fireside the best thought of the day in the shape of papers, daily and weekly, magazines, monthly and quarterly, and books without end. The cream of the most advanced thought of the day in science, literature, art, politics, religion,—everything the teeming press throws off is at the farmer's beck. He can keep his mind free from rust, and while not *of* the world, he is *in* it in the best sense. He is free from the fever and excitement of its active participants, while he looks down upon it all from the vantage-ground of philosophical content. He can spread the live issues of the day on his table and discuss them in the quiet of his rural retreat. With the Pilgrim farmers, when a man cultivated a cabbage, he cultivated a cabbage and nothing else ; but in these days a farmer can cultivate a cabbage and an idea at the same time. Burns cultivated poetry as well as potatoes. The music in him bubbled over spontaneously, and has made classic forever the old town of Ayr and the region thereabout. Everything about him seemed set to music, and his plow rippled through the earth with a music unknown to plows before. Everything ran into verse. When he plowed down a mountain daisy, it bloomed in Burns's immortal lines as it never did before :

> " Wee, modest, crimson-tipped flower,
> Thou'st met me in an evil hour;
> For I maun crush amang the stoure
>                Thy slender stem;
> To spare thee now is past my power,
>                Thou bonnie gem." &c. & so on.

The farmer who can set his plow to music like that is in no danger of going crazy. But all music does not necessarily run in verse, though I think we may all rejoice that Burns did write in verse. But some of the best poetry in the language is in plain prose ; and as a general thing it is better to stick to that, for verse that is only passably good is worse than nothing. Goethe, who was a rare poet, said : "He who would write prose must have something to say ; but he who has nothing to say can make verses and rhymes, for one word gives the other, till at last you have before you what, in fact, is nothing, yet looks as if it were something." On the same point Madame de Staël says : "In any language much more correctness and refinement are required to write well in prose than to write good verse." And Carlyle, speaking of Sterling, says in his own, inimitable Carlylese : "My own advice to him was steady against poetry. Why sing your bits of thoughts if you *can* contrive to speak them ?" Carlyle was a rare old cynic and grumbler, but the world could ill afford to lose the good things he has said. Undoubtedly his pessimistic growls came from the depths of a dyspeptic stomach. There is nothing like a disordered stomach and liver for shutting out the blue sky of heaven and bringing everything to the test of bilious-green goggles. It was said of Mirabeau, of old French Revolutionary fame, that he dipped his pen in bile and not in ink. This applies equally well to Carlyle, but the color of his writing-fluid did not destroy the truths he uttered. If he had laid down his pen and taken up the hoe and wielded it lustily a few hours every day, the demons of dyspepsia would have fled. He might not have written so much, but the growls would have been less, and the quality better. Quality is always of more importance than quantity. Carlyle's is a case where the mind was cultivated too much, the body too little. Huxley says: "Every brain-worker should occasionally let his brain lie fallow for a space. The next crop of thought will certainly be all the fuller in the ear, and the weeds fewer." Huxley, being a great brain-worker himself, no doubt speaks from experience. Steady application to one thing is never desirable; a change is always good. And so the farmer, when wearied with too much manual labor, can seek refuge and rest in books; and the man weary with too much brain-work can seek rest in farm work. Not that farm work does not require brain work, for, so far as I can learn, it requires no small amount of brain labor, quite as much, I should judge, as to produce a sermon, a novel, a poem, a lecture on astronomy, etc. And so the farm, the book, the sermon, the novel, etc., would all be benefited by this interchange of labor. Not that the farmer must necessarily change off on to sermons, poems, or novels, though he might read many of these with profit. Every one, of course, is to be guided by his own taste. The leading thought here is that the field of thought within us should be cultivated as well as cornfields and potato fields; thus only can the grand possibilities latent, more or less, within us all, be given a chance to express themselves in actualities. One of the sacred books of the Hindoos says: "All that we are is the result of what we have thought." The modern school of philosophy teaches that a thought is a thing as substantial as any object we can see in the external world, as an oak tree, a house, a horse, etc.; more real, for these decay and die, while thought is imperishable. The stately cathedral, with its cloistered aisles and its groined arches, its beautiful tracery and carvings, and all its details of elaboration, — the patient work of centuries — all lived and reared itself a perfect, majestic piece of architecture in the human brain before ever it called the workman's hand into requisition. The ship that sails the seas, a marvel of architecture and convenience — an ocean palace with its teeming population, first sailed in human thought. All the beautiful productions in the world of art, lived even more perfectly in thought, before the artist's pencil drew a line, or painter's brush touched canvas. Thought! Thought! It is the world within the world, — the inner world that runs the outer world, from the harvests of the farmer, to the marvelous frescoes of Michael Angelo in Peter's dome.

An ideal farm was started in Massachusetts some forty-five years ago. It was laid out in the thought of its originators, a perfect farm for the benefit of humanity, or the humanity that should take part in it. It was started by the Transcendentalists of New England, a rare company of souls who believed that men and women had in them the elements of the divine if they only had a chance to cultivate it. They have been described in a very few words by Frederika Bremer, and I doubt if it could be done any better. She says: "A Transcendentalist is one who treads the earth as though he were a god; he calls upon men to become gods, and, from the beauty of his demeanor and his character, we are induced to think more highly of human nature."

This farm — which has gone into history as the famous "Brook Farm" — was to be a community farm. All the members were to own it together. Every person who held one or more shares of its stock, or whose labor and skill were considered equivalent to capital, was to be admitted as a member by a two-thirds vote of the association. Emerson, Hawthorne, Margaret Fuller, Channing, Bronson Alcott, George Ripley, and Charles A. Dana were among the leading lights who took an interest in the movement, though Emerson was never a member of Brook Farm, I believe. Horace Greeley also took a lively interest in the ideas upon which it was founded; and he wrote many articles upon the subject and published them in his paper, where also were published many others by Albert Brisbane on the same subject. The establishment of such a community as Brook Farm may be traced back, to a certain extent, to the writings of St. Simon, Fourier, Proudhon, Chevalier, Considerant, and some others. The New Jersey Phalanstery was a similiar outgrowth, as is the present establishment of M. Godin's, at Guise in France, though this is more for beginning at foundation principles, and gives the important place to the education of children. Brook Farm was to be an educational and industrial association for the purpose of substituting "a system of brotherly coöperation for one of selfish competition," according to its constitution. Communistic associations generally annihilate the individual in the interest of the whole, but Brook Farm, while it was owned in common, gave free scope to the development of individuality, which was a noticeable and redeeming point in it. It was open to all sects, and had the most profound regard for individual opinion. Its literary advantages were of no ordinary description, and cultivated men and women were naturally attracted to it. Others took advantage of the free hospitality it offered and lived at the expense of the farm. Its members averaged from year to year about seventy. The farm contained above 200 acres, and was to be enlarged as occasion required. The community held property worth about thirty thousand dollars. The association lasted about six years, or till its main building burnt down in 1847. Hawthorne kept an interesting diary while he was there. April 13, 1841, he writes:

"I have not taken yet my first lesson in agriculture, except that I went to see our cows foddered yesterday afternoon. We have eight of our own, and the number is now increased by a Transcendental heifer belonging to Margaret Fuller. She is very fractious and apt to kick over the milk-pail. I intend to convert myself into a milk-maid this evening, but I pray heaven that Mr. Ripley may be moved to assign me the kindliest cow in the herd, otherwise I shall perform my duties with fear and trembling."

"April 14. I did not milk the cows last night because Mr. R. was afraid to trust them to my hands, or me to their horns, I know not which. But this morning I have done wonders. Before breakfast I went out to the barn and began to chop hay for the cattle, and with such 'righteous vehemence,' as Mr. R. says, did I labor that in the space of ten minutes I broke the machine. Then I brought wood and replenished the fires, and finally went down to breakfast and ate a huge mound of buckwheat cakes. . . . Miss Fuller's cow hooks other cows, and has made herself ruler of the herd, and behaves in a very tyrannical manner."

"April 16. I have milked a cow ! ! ! (This announcement is followed by three scare-points, as the printers say; that, is three exclamation points).

"April 22. I read no newspapers, and hardly remember who is president, and feel as if I had no more concern with what other people trouble themselves about than if I dwelt on another planet."

The following September, after leaving the farm, he writes:

"The real Me was never an associate of the community. There had been a spectral Appearance there, sounding the horn at daybreak, and milking the cows, and hoeing the potatoes, and raking hay, toiling in the sun, and doing me the honor to assume my name. But this spectre was not myself."

Evidently Hawthorne was not cut out for a farmer — certainly not for a Brook farmer. Perhaps the others were not. At any rate, Brook Farm passed away like a beautiful dream. And until the human race can rise above selfishness and materialism, Brook Farms will have to live only in dreams. But I believe things are growing better instead of worse, for nature never takes a backward step; she marches steadily on to the perfecting of her work. Greed and materialism are not always to hold sway. The good, or infinite, that is born in the human soul is bound to extinguish evil and carry the race on to its ultimate destiny, as the sun that rises over the eastern hills is bound to chase away the shadows of night. The sun may be obscured by clouds at mid-day, but the sun is still there, and never wearies in its beneficent work. Evil is always the result of ignorance, and, like the clouds, it is only temporary. It is negative, while good is positive. As the positive sun is bound to be the conqueror over the negative night, so positive good is bound to be the conqueror over negative evil. You cannot drive the negative out of existence, for the two principles are necessary to hold the planet in its orbit. But as the race advances and learns the use of the two, it will be able to guide itself accordingly. The worlds in space sweep on to the music of an infinite harmony, for they are governed by infinite, undeviating law. There is no anarchy there. The laws that guide them on their paths through the unfathomable gulfs of space are as immutable as Infinity.

Sometime — "In the beautiful golden sometime," — the world will have worked itself out of its present crude state of inharmony, war, murder, licentiousness, drunkenness, disease — a brood of evils comparable only to Dante's "Inferno." The time will come when all these things will have waxed old like a garment and will have to be laid away. A new and better world stands awaiting us whenever we are fitted to take possession — we, or some future race that is to follow. In the dawning of that morning, the sun shall stand jocund on the eastern hills, and wars and rumors of wars shall be no more. The red flag of anarchy shall have faded out into the white flag of peace. The seas shall be dotted with the white sails of commerce, bearing tidings of peace and love to all nations. The earth shall laugh with harvests of golden grains and luscious fruits, fit for the food of the gods. The world shall move on, attuned to the harmony of the spheres. We shall not be here. But from the heights of hills eternal, we will "shout our harvest home."

Gov. HYDE. We had anticipated just what we have received from this speaker, "A feast of fat things." I now propose a vote of thanks for this very able and interesting address.

Senator KIRKHAM. I second the motion.

Mr. BILL. I do not know that I have anything to say in particular, only I wondered why the Governor should make the motion he did without embracing in that motion others who have ably addressed us during our stay at this convention. There may be a reason; if so, I should like to hear it. If not, I should wish to amend it by embracing the other ladies and gentlemen who have addressed us.

The amendment proposed by Mr. Bill was accepted and the motion, as amended, passed unanimously.

The CHAIRMAN. Now, ladies and gentlemen, you will be entertained by the music of our quartette.

After the singing the chairman said:

Ladies and gentlemen, we have been favored with the presence of the Secretary of the Massachusetts Board of Agriculture, Mr. William R. Sessions, and it will give us pleasure to hear from him.

Mr. SESSIONS. I have nothing to say to the Connecticut Board of Agriculture, its president and secretary, except to congratulate you all upon the eminent success of this meeting. It has certainly been a most gratifying success, and the feature which has particularly struck me as enjoyable and which I have most enjoyed, perhaps, is the last lecture to which we have listened this evening. (Applause.) It is in a line, as those of you who have attended the meetings of the Massachusetts board know, that we have not enjoyed. Perhaps the example which has been set for us may bear fruit in the future, and we may gain from the experience of our sojourn with you.

I came here a stranger personally to most of the Connecticut Board of Agriculture, and yet not feeling that I was a stranger to Connecticut, for you, Mr. President and ladies and gentlemen, know that this valley was settled on each side of the line, above as well as below, about at the same time and by people from the same locality, the old town of Plymouth in Massachusetts, and that they did not know that there was any line between this part of it and the upper part of it, supposing it to be all under one jurisdiction; and it was years before they found out that there was any line; and in fact the line is now a purely imaginary one. The interests of Connecticut agriculture and Massachusetts agriculture are identical, and I am glad that this year, 1887, the two boards have held their meetings in this beautiful valley, this garden of New England, and that the people on this side of the line, some of them, have been able to enjoy the interesting and valuable lectures which have been delivered before the people on our side of the line, and that some of us have been enabled to enjoy a similar treat here. I hope that the future will bind us more closely together, and that we may, year by year, benefit each other by the eloquence and experience of our agricultural lecturers, and that New England agriculture may get a start and an impetus from those lectures that shall make it eminently successful financially as it now is physically, mentally, and morally. For I do not believe there is any class of people in the world that really enjoy life better than the enterprising, earnest New England farmer. A shiftless man anywhere is not happy; he cannot be; and I have been pleased to hear to-day from some of your farmers here, what has run through my mind for years, and that is, that farming in New England can be a success, can be made to pay, if we only take hold of it as people who are engaged in other pursuits take hold of their business, if they make it pay. If we will only put business principles into our farming, as a successful merchant or a successful manufacturer puts business principles into whatever he undertakes, we shall have success. We shall not become millionaires, but we may get what is far better than money.

Thanking you, sir, for calling upon me, and thanking your worthy secretary, whom I consider my teacher, and upon whom in the future I shall take the liberty of calling for friendly assistance and advice, I beg you to excuse me from saying anything further.

Senator KIRKHAM. We all feel a great deal more than we can express with reference to what we have enjoyed here during this week's convention, and yet I would in a perfunctory manner say one word of thanks and gratitude to our friends here for what they have done for our comfort and enjoyment, and in order that you may all have an opportunity to express what I know are your feelings in this matter, I offer the following resolution:

*Resolved*, That the thanks of this convention be presented to the Hartford County Horticultural Society and to the citizens of Hartford for their hospitality; to those who have furnished the beautiful music; to the press for their assistance; to the railroad managers who have favored us by a reduction of fares; to the exhibitors of fruit, vegetables, and grains, and to all those who have contributed to the success of this 21st winter meeting of the farmers of Connecticut.

Dr. BOWEN. In seconding this motion, as I do most heartily, I think I voice the sentiment of all in saying that we are not only thankful to those corporations and to the individuals who have made our stay so pleasant, but that we feel that we have derived something deeper and more lasting from the instruction which has been given us, than the transitory pleasure we have received. I think these conventions teach us more than the little ideas we gain from time to time that we can take home and carry out upon our farms. They cultivate the inner sense of manhood and power, and when we go home we cultivate our thoughts better, our soils better, our crops better, for the attrition we get from meeting with our neighbors here. It is the cultivation of the finer senses that we get in these conventions that is the most valuable. Therefore, I most heartily second this motion.

Dr. Cressy. In behalf of the citizens of Hartford who have extended their hospitality to this convention, I desire to say that we have felt a unanimity of spirit in relation to your coming here. I think I can say that this has been the best meeting of the Board of Agriculture I have ever attended, and I have been with you fifteen years, more or less. The audiences have been larger than any I have ever seen gathered, and I am sure the citizens of Hartford, through the reports of the press, have taken a very deep interest in these meetings. I desire, in behalf of the citizens of Hartford, to thank you for coming here.

The Chairman. Shall we hear from you, Mr. Myrick?

Mr. Myrick. I suppose I am called upon to say something for the press. In that case I can only think of the progress that has been made since the time of Gutenberg and Faust. The lady essayist reminded us of how printing grew from such a small beginning, and how books in the early days were chained to pulpits and posts. So, many years ago, when these meetings were first established, the knowledge emanating from them was printed only in the annual reports which had a limited circulation.

We are entering upon a period in farming that is going to make it more profitable, in one sense, than it ever has been before, and the responsibility that is coming upon the farmers of the future is going to be far more serious than it has been in the past; the farmers of America are the great conservative power of the country, and we have got to see to it that we discharge our duty as citizens and as honest politicians, as genuine politicians, perhaps, more thoroughly, more earnestly, more patriotically, and in a more God-fearing spirit, than we ever did before. (Applause.)

The question was then put upon the adoption of Senator Kirkham's motion, and it was carried unanimously.

The **Chairman.** Ladies and gentlemen, I know that you will not be content until you hear one more strain from our friends who have so often favored us.

In response to this call the quartette sang a familiar song, which was received by hearty and general applause.

The **Chairman.** If there is no other business before this convention, it is adjourned *sine die.*

# REPORT OF SOME EXPERIMENTS IN POTATO CULTURE FOR 1887.

### By Theron E. Platt, Newtown, Conn.

Continuing my experiments in potato culture the season of 1887, I grew 350 varieties.

The following list embraces one hundred and fourteen varieties of the most value or interest. The ground used was a black loam, containing some clay, with a clay sub-soil.

This particular field was in clover the year previous (1886); the first crop of the clover was cut for hay, the second crop, which was very light, was ploughed under when it was in bloom, about August 15th. Three weeks later the field was harrowed; no more work was done on it until the following spring.

In April of this year (1887) I had forty ox-cart loads per acre of a compost, composed of two-thirds muck and one-third manure, which was mixed the fall previous, spread on the field; the ground was then ploughed eight inches deep; after drying for a few days the field was harrowed, and 800 lbs. per acre of the following fertilizer sown broadcast and lightly harrowed in:

| | |
|---|---|
| 1,250 lbs. | dissolved bone. |
| 500 " | high grade sulphate of potash. |
| 250 " | sulphate of ammonia. |

The drills were now marked out four inches deep and thirty-six inches apart; the planting was done May 9th, the sets of one eye each being placed in the bottom of the drills one foot apart, and the ground leveled off. This is the mode of planting I always follow in my potato experiments; the yield would be larger from a given number of hills if they were farther apart, but my experience is that this distance gives the largest yield per acre. As soon as the rows could be seen the cultivator was passed between them, and as often afterwards as was necessary to keep the ground in good condition and free from weeds.

When the plants were about one foot high we ploughed between the rows with a one-horse sub-soil plow, set to work seven inches deep; this thoroughly pulverized the ground where it had been trodden by the horses while cultivating.

June 25th, when most of the varieties were in bloom, 400 lbs per acre of the same grade of fertilizer was sown between the rows, and the cultivator used for the last time. Prior to this time all weeds had been removed from the rows by hand hoes, but no earth drawn to the plants.

As part of the potatoes ripened they were dug, and the earth which adhered to them was removed. Then the weight of the tubers was registered, and notes made of size, shape, and color. The results are given in the following table.

The notes on the growth of the vines were made when they had attained their full size, those upon the time of ripening when the vines were dead.

The yield of the different varieties was not as large as was expected, with the care that was given.

The explanation is to be found in the fact that the season of 1887 was very unfavorable for the growth of large crops of potatoes, being very dry the early part of the season and very wet afterwards; if the soil had been a sandy loam the yield would unquestionably have been larger, this particular soil being too heavy for the successful growth of potatoes in a wet season. The tubes were free from rot, but some of the vines were damaged by a form of rust, notably the Burbank's seedling, which was dead August 7th, when the tubers were not one-third grown. I have reason to think this rust may have been the cause of the almost total failure of some fields of potatoes. This fungus is entirely different from the one which causes the rot, being somewhat like the rust on the wheat plant.

## 114 VARIETIES OF POTATOES GROWN BY THERON E. PLATT, 1887.

| | NAMES. | Growth of Vines. | Time of Ripening. | Weight best hill. lbs. oz. | Weight 10 hills. lbs. oz. | Color and Shape. | Remarks. |
|---|---|---|---|---|---|---|---|
| 1 | Bliss's Triumph, | Medium, thick, | Aug. 11 | 1— 6 | 10— 0 | Red, round, | Valuable, early variety. |
| 2 | Early Rose, | Medium, | Aug. 18 | 1— 4 | 7—12 | Light red, kidney, | Once very valuable. |
| 3 | Late Rose, | Full, medium, | Sept. 4 | 1— 4 | 9— 2 | Light red, kidney, | Not very valuable. |
| 4 | Storrs' Seedling, | Large, | Aug. 30 | 1— 4 | 8—12 | Light red, oval, | Some value. |
| 5 | Belle, | Large, strong, | Sept. 7 | 1—12 | 10— 0 | Light red, oval, | Poor quality. |
| 6 | White Flower, | Strong, | Sept. 6 | 2—12 | 18— 0 | White, kidney, | Good quality and yield. |
| 7 | White Star, | Full, medium, | Aug. 26 | 0—12 | 3— 0 | White, long, | Killed by the rust. |
| 8 | Pride of America, | Thick, spreading, | Sept. 4 | 1— 0 | 7— 3 | White, round, | Good quality. |
| 9 | Scotch Hero, | Strong, erect, | Aug. 30 | 0—11 | 6— 0 | White, round, | From Scotland. |
| 10 | Queen of the Valley, | Large, rank, | Sept. 6 | 2— 4 | 12— 6 | Light red, oval, | Poor quality. |
| 11 | White Elephant, | Large, | Sept. 12 | 2— 0 | 12— 0 | Pink & white, long, | Some value. |
| 12 | Early Beauty of Hebron, | Medium, | Aug. 25 | 1— 8 | 11— 0 | Pinkshaded, kidney, | Quality good. |
| 13 | Coy Seedling, No. 49, | Full, medium, | Aug. 18 | 1—12 | 12— 4 | White, oval, | New, valuable. |
| 14 | Clark's No. 1, | Medium, | Aug. 17 | 1— 8 | 11— 0 | Red, kidney, | Well known. |
| 15 | Early Perfection, | Full, medium, | Aug. 30 | 2— 6 | 12— 6 | Light red, long, | Some value. |
| 16 | Early Telephone, | Thick, spreading, | Aug. 16 | 1— 0 | 6— 4 | White, oval, | Like Snowflake. |
| 17 | Early Sunrise, | Full, medium, | Aug. 20 | 2— 0 | 14— 0 | Light red, kidney, | Valuable. |
| 18 | Rosy Morn, | Large, | Aug. 28 | 1—12 | 11— 0 | Light red, kidney, | Valuable. |
| 19 | Rubicund, | Large, | Sept. 6 | 1— 0 | 8— 8 | Red, oval, | Good quality. |
| 20 | Chicago Market, | Full, medium, | Aug. 14 | 1—12 | 12—14 | Light red, kidney, | Valuable. |
| 21 | Winslow's Seedling, | Medium, to large, | Sept. 6 | 1— 4 | 8— 9 | Red, kidney, | Rose family. |
| 22 | Early Maine, | Full, medium, | Aug. 16 | 1— 2 | 9—12 | Red, kidney, | Valuable. |
| 23 | Garfield, | Thick, spreading, | Sept. 2 | 1—12 | 11— 8 | White, oval, | Valuable. |
| 24 | Charter Oak, | Tall, erect, | Aug. 25 | 1— 4 | 6—12 | White, p'keyes, r'nd, | Tubers small. |
| 25 | Early Ohio, | Full, medium, | Aug. 14 | 1— 0 | 8—12 | Red, oval, | Not valuable here. |
| 26 | Brownell's Success, | Thick, spreading, | Aug. 25 | 0—12 | 7—14 | White, round, | First quality. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 27 | Dakota Red, | Medium, | Sept. 6 | 1— 0 | 8— 0 | Red, oval, | Not valuable. |
| 28 | Weld's Jumbo, | Large, strong, | Sept. 10 | 2— 0 | 14— 0 | White, oblong, | Valuable. |
| 29 | Ricker's Graft, | Large, | Sept. 4 | 2— 0 | 14— 0 | Light red, oblong, | Valuable. |
| 30 | O. K. Mammoth Prolific, | Full, medium, | Sept. 6 | 1— 8 | 11—12 | White, heart shape, | Valuable. |
| 31 | Knapp's Snowbank, | Large, | Sept. 6 | 1— 0 | 7— 3 | White, oval, | Some value. |
| 32 | Watson's Seedling, | Medium, | Aug. 23 | 0—13 | 7— 4 | Light red, oblong, | Rose family. |
| 33 | Lee's Favorite, | Full, medium, | Aug. 17 | 1— 6 | 9 6 | Light pink, kidney, | Some value. |
| 34 | Home Comfort, | Large, thick, | Sept. 6 | 1—12 | 12—12 | Red, long, | Much value. |
| 35 | Jones' Prize Taker, | Large, | Sept. 3 | 2— 0 | 13— 8 | Light pink, oval, | Valuable. |
| 36 | Steuben Chief, | Full, medium, | Sept. 2 | 1— 2 | 8— 3 | Light pink, oval, | Large size. |
| 37 | Pearl of Savoy, | Full, medium, | Aug. 21 | 1— 4 | 11— 3 | Light red, kidney, | Some value. |
| 38 | Andrews' White Rose, | Thick, spreading, | Aug. 22 | 1—12 | 11— 4 | White, round, | First quality. |
| 39 | Granger, | Thick, spreading, | Sept. 6 | 1— 3 | 8—10 | White, round, | Some value. |
| 40 | Mitchell's Seedling, | Full, medium, | Sept. 7 | 1— 8 | 9— 2 | Dark, round, | Best dark variety. |
| 41 | Churchill's Seedling, | Large, | Sept. 4 | 1—12 | 9— 3 | White, oval, | Some value. |
| 42 | Late Snowflake, | Large, thick, | Sept. 6 | 1— 8 | 8— 4 | White, oval, | First quality. |
| 43 | Gipsy, | Large, | Aug. 29 | 1— 6 | 10—14 | White, oval, pointed, | Some value. |
| 44 | Carter, | Large, strong, | Sept. 7 | 2— 4 | 12— 4 | White, round, | An old variety. |
| 45 | Tonhocks, | Full, medium, | Aug. 15 | 1—14 | 12— 3 | Light pink, oval, | New, valuable. |
| 46 | Rhinebeck, | Large, strong, | Sept. 6 | 1— 8 | 11— 0 | Light red, long, | Some value. |
| 47 | White Mountain, | Large, | Sept. 3 | 1— 8 | 11— 8 | White, round, | Valuable. |
| 48 | Burpee's Empire State, | Full, medium, | Aug. 25 | 1— 8 | 6— 8 | White, long, | Value small here. |
| 49 | Alexander's Prolific, | Large, strong, | Sept. 6 | 2— 1 | 13— 4 | White, oval, | Valuable. |
| 50 | Baker's Imperial | Large, | Sept. 1 | 1— 8 | 9— 8 | Red, kidney, | Some value. |
| 51 | White Beauty of Hebron, | Large, strong, | Sept. 6 | 1—12 | 11— 0 | Light, long, | Valuable. |
| 52 | Rose of Hebron, | Medium, | Aug. 22 | 1— 2 | 8— 8 | Light pink, oblong, | Some value. |
| 53 | Cambridge Prolific, | Large, thick, | Sept. 7 | 2— 0 | 12— 2 | White, kidney, | Valuable. |
| 54 | Rose's New Seedling, | Large, | Sept. 6 | 1— 8 | 10— 8 | White, heart shape, | Valuable. |
| 55 | Buffalo Beauty, | Large, | Sept. 7 | 1— 8 | 10— 4 | White, oblong, | Some value. |
| 56 | Parsons' Prolific, | Full, medium, | Sept. 8 | 1— 4 | 9— 2 | White, round, | Some value. |
| 57 | Newton's Seedling, | Large, | Aug. 30 | 1— 8 | 9— 0 | White, kidney, | Valuable. |
| 58 | Banana, | Large, strong, | Sept. 7 | 1—12 | 12— 0 | White, oblong, | Valuable. |
| 59 | Enos' Seedling, | Large | Sept. 7 | 1— 8 | 7— 8 | White, long, | Valuable. |
| 60 | Webb's Early, | Full, medium, | Aug. 20 | 1— 3 | 7—14 | Red, kidney, | Some value |

## 114 VARIETIES OF POTATOES GROWN BY THERON E. PLATT, 1887.—CONTINUED.

| | NAMES. | Growth of Vines. | Time of Ripening. | Weight best hill. lbs. oz. | Weight 10 hills. lbs. oz. | Color and Shape. | Remarks. |
|---|---|---|---|---|---|---|---|
| 61 | Hercules,.............. | Large,............ | Sept. 8 | 1— 8 | 11— 0 | Red, long,.......... | Some value. |
| 62 | Sword Potato,...... .... | Large,............ | Aug. 31 | 1— 8 | 11— 0 | White, long,........ | Value small. |
| 63 | Astonisher,............ | Large,............ | Sept. 11 | 1— 4 | 10— 0 | Red, round,......... | Some value. |
| 64 | McFaden's Seedling,.... | Large,............ | Sept. 6 | 1— 8 | 11— 0 | White, oval,........ | Some value. |
| 65 | Collum's Superb,........ | Large,............ | Aug. 31 | 1— 0 | 8— 0 | White, long,........ | Very smooth. |
| 66 | Queen of Roses,......... | Large, strong,...... | Sept. 1 | 2— 0 | 10— 0 | Red, long,.......... | Valuable. |
| 67 | Rose's Invincible,...... | Large,............ | Sept. 7 | 1—12 | 10— 0 | White, oval,........ | Some value. |
| 68 | Bonanza,.............. | Large, strong,...... | Sept. 6 | 2— 0 | 11— 0 | Light red, kidney,.. | Valuable. |
| 69 | Great Eastern,.......... | Large,............ | Sept. 7 | 1— 8 | 10— 8 | White, round,...... | Valuable. |
| 70 | Indian Beauty,.......... | Large,............ | Sept. 5 | 1— 8 | 11—12 | Light red, oval,.... | Some value. |
| 71 | Barstow, .............. | Large,............ | Sept. 6 | 1— 4 | 10— 0 | Light red, long,.... | Some value. |
| 72 | New Queen,............ | Full, medium,...... | Aug. 20 | 1— 8 | 10— 0 | Light red, oval,.... | Valuable. |
| 73 | Dictator, .............. | Large,............ | Sept. 3 | 1— 4 | 12— 8 | White, round,...... | Some value. |
| 74 | Prairie Farmer,......... | Full, medium,.. ... | Aug. 23 | 1— 8 | 10— 8 | White, round,...... | Some value. |
| 75 | White Chief,........... | Large,............ | Sept 6 | 1—12 | 9— 2 | White, heart shape,. | Tubers large. |
| 76 | Vick's Extra Early,..... | Thick, spreading,.. | Aug. 28 | 1—12 | 9— 2 | White, oval,........ | Valuable. |
| 77 | New Champion,......... | Large, strong,...... | Sept. 6 | 2— 0 | 12— 0 | White & pink, long, | Valuable. |
| 78 | The Thorburn,.......... | Medium,.......... | Aug. 17 | 1— 0 | 8—14 | Pink, oval,......... | Like Beauty of Hebron. |
| 79 | Pride of the West,...... | Large,............ | Sept. 6 | 1—12 | 11—12 | White, round,...... | Some value. |
| 80 | Early Essex,........... | Medium,.......... | Aug. 15 | 1— 0 | 7— 8 | Light red, oval,.... | Valuable on light soil. |
| 81 | Gen. Logan,............ | Full, medium,...... | Aug. 25 | 1—10 | 10— 4 | Red, oval,.......... | Some value. |
| 82 | Green Mountain,........ | Large,............ | Sept. 5 | 1— 8 | 11— 0 | White, oval,........ | Valuable. |
| 83 | Potentate, ............. | Full, medium,...... | Aug. 28 | 1—10 | 9— 6 | Light yellow, round, | Some value. |
| 84 | Spaulding,............. | Large,............ | Aug. 25 | 1— 8 | 9— 0 | White, oval,........ | Valuable. |
| 85 | Corliss' Matchless,...... | Large,............ | Sept. 2 | 1— 4 | 9— 0 | Light red, oblong,.. | Some value. |
| 86 | State of Maine,......... | Large,............ | Sept. 6 | 1— 4 | 10— 0 | White, oval,........ | Valuable. |
| 87 | Early Pearl,............ | Full, medium,...... | Aug. 19 | 1—10 | 10— 2 | Light red, oblong,.. | Valuable. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 88 | Red Star, | Large, | Sept. 1 | 1— 4 | 8—12 | Red, oval, | Value small. |
| 89 | Everitt, | Large, | Sept. 1 | 1—12 | 11— 2 | Pink, oblong, | Valuable. |
| 90 | Connecticut, | Large, strong, | Sept. 5 | 1— 4 | 7— 0 | White& p'k, oblong, | New, promising. |
| 91 | Moore's Seedling, | Large, | Sept. 3 | 1— 8 | 10— 8 | Pink, kidney, | Valuable. |
| 92 | Red Cloud, | Full, medium, | Sept. 2 | 2— 0 | 11— 0 | Red, long, | Quality 2d. |
| 93 | Manson's Seedling, | Medium, | Sept. 5 | 1— 4 | 11— 0 | White, oblong, | Some value. |
| 94 | Seneca Red Jacket, | Large, | Aug. 31 | 1—12 | 11— 0 | Light red, oval, | Some value. |
| 95 | Cheeseman's Seedling, | Large, | Aug. 31 | 2— 8 | 15— 0 | White, round, | Valuable. |
| 96 | Eureka, | Large, | Sept. 2 | 1—12 | 12— 8 | White, round, | Some value. |
| 97 | Crimson Beauty, | Large, strong, | Sept. 5 | 2— 0 | 10— 8 | Red, kidney, | Valuable. |
| 98 | American Monarch, | Full, medium, | Aug. 30 | 1— 0 | 8— 8 | Light yellow, round, | Some value. |
| 99 | Dun's Seedling, | Full, medium, | Sept. 6 | 1— 4 | 7— 4 | White, round, | Large size. |
| 100 | Chief, | Large, | Sept. 5 | 1— 8 | 10— 8 | White, long, | Some value. |
| 101 | Conquest, | Large, rank, | Sept. 1 | 2—10 | 11— 2 | White & pink, long, | Some value. |
| 102 | Peerless Peachblow, | Tall, erect, | Sept. 6 | 2— 0 | 11— 0 | Red, round, | Deep eyes. |
| 103 | Iowa Beauty, | Tall, erect, | Sept. 4 | 2— 0 | 12— 0 | Light pink, oval, | Valuable. |
| 104 | Early Dawn, | Large, | Sept. 1 | 1—12 | 12— 4 | White, long, | Some value. |
| 105 | Keystone, | Medium, | Aug. 15 | 1— 0 | 7— 0 | Red, oval, | Small value. |
| 106 | Harmony, | Full, medium, | Aug. 18 | 2— 4 | 12— 0 | Light pink, oval, | Valuable. |
| 107 | Thunderbolt, | Full, medium, | Sept. 1 | 1— 4 | 10— 0 | White, oval, | Some value. |
| 108 | Rankin's Racer, | Medium, | Aug. 16 | 1— 4 | 10— 4 | Pink, oval, | Valuable. |
| 109 | Tunix, | Large, | Sept. 2 | 1— 6 | 8—10 | White, oval, flat, | Some value. |
| 110 | Charles Downing, | Full, medium, | Aug. 11 | 1— 8 | 10— 0 | White, oval, | Valuable. |
| 111 | Summit, | Full, medium, | Aug. 24 | 1—12 | 8— 4 | Pink, kidney, | Valuable. |
| 112 | Crane's June Eating, | Medium, | Aug. 7 | 1— 3 | 8— 0 | Light pink, oval, | Some value. |
| 113 | Morning Star, | Large, | Sept. 1 | 2— 0 | 12— 0 | White, long, | Like White Star. |
| 114 | Sunset, | Large, | Sept. 1 | 2— 0 | 11— 0 | Light red, kidney, | Valuable. |

## REPORT OF P. M. AUGUR, POMOLOGIST.

The year 1887 was a year of general fruitfulness. Although the odd year, yet many sections of the State gave an abundant crop of apples, specially in the Connecticut valley.

Pears yielded a fair but not excessive crop. Peaches were grown in abundance: probably no crop of this fruit in our State for many years has equaled the last in excellence and quantity, and although there are serious discouragements in peach-growing, there is quite a disposition on the part of many to plant more peach trees than heretofore.

The plum has shown during the past few years an unusual tendency to the black knot fungus, which is very damaging and requires the utmost care to exclude it, the only known preventive being to cut off rigorously at sight. Yet notwithstanding this drawback, healthy trees were to a great extent very productive, especially so where requisite care was used to prevent the attacks of curculio. This insect need no longer be the special dread of the plum grower, there being three or four ways of avoiding his depredations. 1st. By jarring the trees, catching and killing daily during the curculio season. 2d. Enclosing the plum patch and stocking with poultry. 3d. Drenching the trees during the curculio season with some very offensive wash. 4th. Spraying the trees, commencing quite early, with some insecticide, and repeating the operation two or three times or until the curculio season is past.

The plum is a beautiful and delicious fruit, and can be raised successfully by complying with the requisite conditions.

The grape crop was fairly good on well managed vines, but mildew and the grape-rot are, and probably will be, serious drawbacks in cultivating the finer grapes.

Cherries we think as a whole in the State were fairly successful. The small fruits generally gave a satisfactory crop where they had good culture.

The quince did reasonably well, but needs better culture, shallow culture, and heavier manuring than it usually receives.

The Nectarine and Apricot are so difficult to succeed with, that failure is the rule and success the exception. To the average planter we advise caution in planting either. The Nectarine is no better than the peach, and far more difficult to raise.

Many inquiries have been addressed to me regarding the Russian apricot. As a matter of fact, as disseminated, it is likely to disappoint. A few named varieties are worthy of trial, among these the *Alexis*, Catherine, Nicholas, J. L. Budd, and Gibb; but the average seedling Russian apricot at a high price you may mark doubtful. Tell the tree agent to furnish the county testing stations, sample trees, and await their report, unless you like to make a doubtful investment.

The same remark may also have a much wider application.

### *Strawberry Exhibit.*

This show in June, 1887, was at Bridgeport, Conn. The day was exceptionally stormy, so that the streets and walks were flooded with water, the weather to a great extent preventing visitors as well as exhibitors from being present. Exhibits of apples from T. S. Gold were as usual representing "Cream-Hill" in beauty and quality. Some exceptionally fine berries from R. Bartlett, Esq., of Guilford, Conn., of the "Jewell." A collection from P. M. Augur & Sons, Middlefield, Conn., representing several of their new seedlings, specially "Jewell," "Dewey," and "Gold." A very attractive exhibit from the grounds of Dr. O. S. Hubbell of Stratford, comprising several plants loaded with beautiful trusses of fruit of a new seedling of the "Golden Defiance," which he names the "Gen. Noble." It promises to be worthy of the name it bears. Several dishes from Mr. Nichols of West Stratford, among which were some remarkable specimens of the "Jersey Queen," which does well on his grounds, beside small exhibits from several other parties.

Gen. Noble of Bridgeport, also had a collection of several varieties of exceptionally fine cherries. Had the weather been good the exhibit would undoubtedly have been worthy of the place and the occasion.

### *Field Days.*

Early in September last, G. H. & J. H. Hale of South Glastonbury, invited members of the Board of Agriculture, and many others, to visit their extensive peach orchards and see their remarkable crop of peaches. A steamer was chartered from Hartford, which brought a crowd of visitors to the grounds, beside those who came by railroad and private conveyances. A more heavily laden orchard we never saw, many of the trees being overloaded, notwithstanding, we were informed, that much thinning had been done. The crop yielded several thousand baskets, which sold at good prices, and showed conclusively that it is possible to raise good peaches in Connecticut.

Another remarkable showing on Messrs. Hale's grounds was the autumn crop of Earhart raspberries. It was a surprise and wonder to all who saw them: the canes were literally loaded with delicious fruit.

The Hale brothers are indefatigable workers, full of push and energy, and their reputation is becoming world-wide.

A sumptuous collation was served on the lawn under those beautiful Elms which give *name* to their fruit-farm.

Many from our own State as well as from other States enjoyed the occasion. At its close a vote of thanks was tendered to the Messrs. Hale and to Mrs. Hale for the day so full of enjoyment, courtesy, and good cheer.

The following day we were in like manner invited to visit a young orchard of the Connecticut Valley Orchard Co., at Berlin, Conn. This is a joint stock company having two extensive orchards, one at Berlin and another still larger at Deep River, Conn.

Neither of these orchards have yielded a crop yet, but are in fine condition to do so in the near future. The company has had a wonderful amount of pluck in their enterprise, and after patient waiting we think will meet an abundant reward.

Here also a collation was served, in which the Berlin Grange took a conspicuous part, and after feasting and speech-making and a most enjoyable social time, visitors took trains, which by arrangement stopped at the grounds.

These field days are a very practical way of gaining instruction. They illustrate a point made by a good old Scotch farmer, to wit: "A minute's observation is better than an hour's description." "Seeing is believing." A few days in each year open to the public in this way, viz.: to see examples of eminent success in any line of Agriculture or Horticulture, cannot be too much encouraged.

## REPORT

### OF THE EXHIBIT AT THE WINTER MEETING OF THE CONNECTICUT BOARD OF AGRICULTURE, AT UNITY HALL, HARTFORD, CONN.

As usual for many years the exhibit of fruits, corn, grain, and vegetables was an interesting adjunct of the meeting. The largest variety of dishes of winter apples came from Secretary T. S. Gold, embracing some fifty-six varieties, and three of pears. P. M. Augur & Sons of Middlefield, exhibited sixty-four dishes of apples, a considerable number being duplicates, with four varieties of winter pears, and two varieties corn. Secretary Andross of the Connecticut State Agricultural Society, from East Hartford, a bunch of remarkably fine horse-radish roots, also a new seedling potato, unnamed, but of fine appearance, Early Essex, and several other varieties, Early Danvers half-long carrot, Fallawater apple, Golden Canada pie pumpkin, and Wethersfield red onion. F. W. Richardson, East Hartford, forty greenhouse plants for decoration. R. S. Hinman, Assistant Secretary of State, seventeen dishes of apples, including his noted Golden Reds, and samples of raspberry cane. Frederic W. Doolittle, Cheshire, six plates of apples. Sherman Kimberly, Torrington, four dishes apples, including Patron's Favorite. D. E. Peck, Whigville, Peck apple. J. N. Whiting, Torrington, seven dishes of apples and one of corn. Abner Trask, East Hartford, seven parcels of corn, three large squashes, seven of potatoes, ten smaller squashes, two of turnips, and five of apples. Everett B. Clark, Milford, two varieties of sweet corn, one of carrots. H. Wakeman, Saugatuck, two varieties of potatoes, and White Globe onion. Julius Yale, Meriden, Benton corn. M. W. Frisbie, Southington, Fall Pippin apples. Theron E. Platt, Redding Ridge, two kinds quinces. L. S. Wells, Burritt Grange, New Britain, hybridized corn, six varieties apples, and six of potatoes. Storrs School, Mansfield, four varieties of corn. M. W. Frisbie, Southington, Canada improved corn. L. Barbour, Union Grange, Southington, a seedling, the Barbour apple, worthy of culture. Dennis Fenn, Milford, three varieties corn. D. N. Van Hoosear, Wilton, three varieties potatoes, one of apples, one sample of tobacco. DeWitt apple of fine quality from J. R. Bostwick, New Milford. An excellent photograph of exhibit of South Windsor Grange. Two cans of Meech's quince, one of Lima beans, from Rev. Mr. Meech, Vineland, N. J. Burritt Grange, New Britain, twenty-two dishes of apples, nine varieties corn, thirteen varieties potatoes. W. E. Wallace, Hartford, from gardens of Ellwanger & Barry, two large platters of extra fine Anjou pears. Geo. Maxwell, Rockville, Josephine de Malines pears, also photograph of East Windsor creamery. Mr. Hunt, Columbia, seventeen dishes of apples. Mr. S. F. West, Columbia, a fine photograph of the great Columbia elm. N. S. Baldwin, Meriden, cinders from the extinct volcano of that town. Peck Bros., Northfield, the Maxim bush puller, a promising implement for a team, nine samples of ground bone and fertilizers, a potato masher. Mr. Smith, Middlefield, three dishes of apples and two of corn. The Experiment Station of New Haven, samples of grasses grown on their experimental grounds, which made an interesting study. Richard A. Wheeler, Stonington, Prentice Russet, with historical sketch of the tree. A most interesting exhibit from H. L. Jeffrey, New Preston, embracing several cans of honey of basswood, white clover, and other flowers, of superb quality, as we found by testing it. Mr. Jeffrey showed two combs to illustrate the benefit of reversing the combs to get them built solid in the frames; one frame to show how wired to strengthen the comb and how to reverse; one exhibit to show the destruction of the comb by the bee moth; two styles of drone traps and excluders; two samples of extracted honey; one queen shipping cage; one cage for introducing queens; a sample of comb foundation, the base or center wall; one set of wires for reversing; one set of wires to hold transfer combs; and an exhibit of comb honey in the most marketable shape. Warren A. Doolittle, Clinton, Pride of North field corn and "Doolittle turnip," originated by him. A. W. Hutchinson, Gilead, Manchester Beauty. R. A. Moore, Kensington, six dishes of Winter pears. Geo. E. Howell, Ann street, Hartford, sample Winter pears, unnamed. The exhibit embraced two hundred and eleven dishes of fruit and fifty-six of vegetables. A large collection of dried grasses from the Connecticut Experiment Station, forty greenhouse plants for decoration, twenty-seven varieties field and sweet corn, thirty-six miscellaneous articles. Considering the exhibit as a whole it was both varied, full, and instructive, and reflects credit upon the exhibitors and the Agriculture of our State.

Respectfully, P. M. AUGUR, *Pomologist.*

## HISTORICAL SKETCH

### OF THE TREE FROM WHICH THE "PRENTICE RUSSETS" WERE GATHERED IN 1887.

The tree was grafted in the year 1730. The bud or graft used was taken from a tree that was brought to Stonington by Mr. Samuel Prentice of Newton then, Cambridge now, of Massachusetts, when he came here to reside, and the fruit therefrom took his name.

This tree was taken from the nursery and transplanted in 1733, where it grew to a large size, bearing fruit each and every year to 1815, when it was blown down in the terrible gale of that year. After the tree was prostrated by the gale its body was supported in part by a heap of stones placed one upon another thereunder to the height of about three feet, fifteen feet from the original root. In this condition the tree continued to bear fruit until 1878, when its body began to decay and rot.

About the same time a sprout or limb started to grow out from the underside of the tree beyond the heap of stones upon which it lay, and unassisted in any way entered the ground and rooted, and rapidly increased in size above and below the surface of the ground.

Meantime the body of the tree, all the way between the original root and the heap of stones, continued to decay until 1885, when about fifteen feet thereof rotted out entirely and was removed.

The top, or branches of the old tree beyond the heap of stones, and the new limb and its roots, have been kept in vigorous growth and good condition by the same, bearing more or less fruit every year. This year it produced two barrels of marketable apples, of which the fruit enclosed is a fair sample.

The limb of the old tree transplanted one hundred and fifty-four years ago seems to be putting on a new life and growth from the nourishment derived from the new trunk and its vigorous roots, which now bids fair from appearances to grow and expand to the full size of the original tree.

So far as known this tree has never failed to bear fruit every year, notwithstanding its prostration by the gale and the loss of some fifteen feet of its trunk.

RICHARD A. WHEELER.

STONINGTON, CONN., Dec. 10, 1887.

THE CHEMICAL LABORATORY AT THE STORRS SCHOOL.

## STORRS AGRICULTURAL SCHOOL.

Some facts in the progress of this school should form part of our permanent record.

The new laboratory is just completed, and is now ready for occupancy. It is of one story, thirteen feet high, with attic for storage, and with cemented cellar. It is thirty-five feet wide, and sixty-four feet long, with open and closed porches. It is heated by furnace, and provided with gas for light and chemical purposes. It is well lighted with seventeen windows eight and one-half feet high. Ventilation is secured above, while suitable hoods are provided at each table to carry off the gases; and no pains have been spared to render it perfect in all its arrangements. The main room contains thirty working tables for students, with closets and drawers. There is also a lecture-room, and private office for the professor. Total cost, $7,000.

A new barn, forty by eighty feet, is under contract, to be completed in season for the coming harvest, and much of the timber is on the ground.

The Hatch bill fund, providing $15,000 annually for experiment stations in each State, has been by act of General Assembly divided between the State Experiment Station at New Haven, and the Storrs Agricultural School. This will not be directly available for teaching purposes or the support of the school; yet the work will be so planned as to encourage and develop, both at the school and elsewhere, an interest in a more intelligent and of course more successful system of agriculture. Fifteen hundred dollars is immediately available for building purposes, and a library and office will be erected.

At a meeting of the trustees, held in Hartford March 27th, the Station was organized by the appointment of Professor W. O. Atwater of Middletown, as Director, and C. S. Phelps of West Hartford, as Vice-Director; T. S. Gold, J. M. Hubbard, B. F. Koons, Executive Committee.

## OFFICIAL LIST OF AGRICULTURAL SOCIETIES IN CONNECTICUT.

| NAME OF SOCIETY. | PRESIDENT. | SECRETARY. | TREASURER. |
|---|---|---|---|
| Connecticut State, | James A. Bill, Lyme, | W. F. Andross, East Hartford, | S. H. W. Yale. |
| Hartford County,* | J. C. Capen, Bloomfield, | Warren Rowley, Hartford, | Wm. H. Gross. |
| New Haven County,* | D. N. Clark, Woodbridge, | C. P. Augur, Whitneyville, | Frank S. Platt. |
| New London County, | James A. Bill, Lyme, | Wm. T. Cook, Ledyard, | John D. Brewster. |
| Fairfield County, | Thomas L. Watson, Bridgeport, | Edwin Hoyt, New Canaan, | Wm. A. Curtis. |
| Windham County, | Frank Day, Brooklyn, | Theo. D. Pond, Brooklyn, | Charles S. L. Marlor. |
| Litchfield County,* | H. Sedgwick, Cornwall Hollow, | D. C. Kilbourn, Litchfield, | E. C. Jones. |
| Middlesex County,* | J. M. Hubbard, Middletown, | G. W. Wilson, Middletown, | G. W. Wilson. |
| Tolland County, | W. W. Cowles, Manchester, | F. R. Tucker, Rockville, | Frank Grant. |
| Berlin, | R. A. Moore, Kensington, | Frank L. Wilcox, Berlin, | Theron Upson. |
| Bloomfield,* | H. G. Fish, Bloomfield, | J. E. Cox, Bloomfield, | H. W. Rowley. |
| Bristol Park Co., | Wallace Barnes, Bristol, | C. F. Barnes, Bristol, | M. L. Peck. |
| Cedar Valley,* | Levi S. Wells, New Britain, | John S. Kirkham, Newington, | E. F. Blake. |
| Chester, | Joseph E. Silliman, Chester, | E. G. Smith, Chester, | E. G. Smith. |
| Clinton, | S. B. Carter, Clinton, | S. S. Wilcox, Clinton, | E. E. Post. |
| Danbury, | P. D. Crosby, Danbury, | B. C. Lynes, Danbury, | J. W. Bacon. |
| East Granby, | C. H. Hanchett, East Granby, | Wilbert H. Gay, East Granby, | Clinton Phelps. |
| Farmington Valley, | J. H. Foote, New York, | E. A. Hough, Collinsville, | O. F. Perry. |
| Guilford, | John Benton, Guilford, | George L. Griswold, Guilford, | George B. Spencer. |
| Harwinton, | Cornelius Colt, Harwinton, | A. W. Buell, Harwinton, | J. M. Baldwin, Sr. |
| Killingworth,* | D. K. Stevens, Killingworth, | N. H. Evarts, Killingworth, | A. B. Stevens. |
| Madison, | John H. Meigs, Madison, | J. Myron Hull, Madison, | J. Myron Hull. |
| Meriden,* | W. J. Ives, Meriden, | L. E. Coe, Meriden, | S. H. W. Yale. |
| New Milford,* | L. F. Curtiss, New Milford, | W. F. Hurlburt, New Milford, | D. E. Soule. |
| Oxford,* | W. B. McEwen, Oxford, | Wm. W. Hughes, Oxford, | E. B. Treat. |
| Simsbury, | N. W. Holcomb, West Simsbury, | A. G. Case, Simsbury, | A. G. Case. |
| Southington, | E. E. Stow, Plantsville, | W. H. Cummings, Plantsville, | W. H. Cummings. |
| Stafford, | E. H. Hyde, Stafford, | D. H. Parsons, Stafford Springs, | A. Howard. |
| Suffield,* | Dwight S. Fuller, Suffield, | W. F. Fuller, Suffield, | W. F. Fuller. |
| Union (Somers, etc.), | Myron F. Gowdy, Somerville, | Calvin M. Havens, Somers, | S. T. Kimball. |
| Union (Monroe, etc.), | James Burr, Monroe, | Joseph Tomlinson, Birmingham, | D. S. Clarke. |
| Watertown, | W. G. French, Watertown, | A. H. Scoville, Watertown, | B. H. Mattoon. |
| Westbrook, | L. Eckford Post, Saybrook, | C. H. Chapman, Westbrook, | T. D. Post. |
| Willimantic, | E. S. Boss, Willimantic, | O. H. K. Risley, Willimantic, | W. C. Jillson. |
| Woodbridge and Bethany, | C. C. Hitchcock, Woodbridge, | S. G. Davidson, Bethany, | S. G. Davidson. |
| Wolcott, | H. B. Carter, Wolcott, | E. M. Upson, Wolcott, | E. M. Upson. |
| Woodstock, | Henry T. Child, Woodstock, | L. J. Wells, South Woodstock, | A. M. Paine. |

*No Fair.

## RETURNS OF AGRICULTURAL SOCIETIES, 1887.—FINANCES—RECEIPTS.

| SOCIETIES. | Cash on Hand. | Single Admission Tickets. | Membership or Season Tickets. | Grand Stand. | Donations and Unclaimed Premiums. | Entrance Fees. Trials of Speed. | Other Entrance Fees. | Rent of Grounds. | State Appropriation, 1886. | Other Sources. | TOTALS. | State Appropriation, 1887. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Connecticut State, .. .. | $1,019.08 | $5,421.54 | $519 00 | $236.35 | ...... | $644 00 | $22.00 | $671.50 | $2,500.00 | $151.10 | $11,184 57 | $2,500 00 |
| New London County,. .. | 102.98 | 2,925.52 | 80.00 | 138.89 | $319.00 | 740.50 | 110 00 | 505.82 | 206.75 | 1,600.87 | 6,880.33 | 258.19 |
| Fairfield County, .. .. .. | ........ | 2,319.98 | ...... | 410.50 | 200.00 | 978.75 | 82 65 | 588.00 | 194.95 | 2,221.30 | 6,996.18* | 240.09 |
| Windham County, .. .. | 62.62 | 930 97 | ...... | 113.35 | 29.25 | 191.50 | 47.00 | 325 00 | 214.17 | 173.25 | 2,087.11 | 262.33 |
| Tolland County, .. .. .. | ...... | 2,007 85 | 393.02 | 165.84 | 97.68 | 275.00 | 25.75 | 290 25 | 173 14 | 169 39 | 3,537.92 | 193.22 |
| Berlin, .. .. .. .. .. | 108.07 | 193.40 | 47.00 | 7.80 | 1 75 | ....... | 14.00 | ........ | 101.90 | 77 89 | 551.81 | 127.71 |
| Bristol Park Co., .. .. .. | ........ | 1,033.45 | ...... | 23.25 | ...... | 165.00 | 31.50 | 190.05 | ........ | 9.95 | 1,453.20 | 261 98 |
| Chester, .. .. .. .. .. | 12.16 | 95.00 | 44.75 | ........ | 8.50 | ........ | ...... | 7.00 | ........ | 13.80 | 176.21 | 125 93 |
| Clinton, .. .. .. .. .. | 82.35 | 63.05 | 59.00 | ........ | 8.30 | ........ | 8.50 | 9.00 | 134.28 | 107 00 | 471.48 | 115.74 |
| Danbury,.. .. .. .. .. | 5,129.01 | 12,462.30 | 30.00 | 2,728.60 | ...... | 1,150.00 | 33.00 | 8,784.16 | 734.08 | 299.57 | 26,860.72 | 869.87 |
| East Granby.. .. .. .. | ........ | ........ | ...... | ........ | 100.50 | ........ | ...... | ........ | ........ | ........ | ........ | 115.24 |
| Farmington Valley, .. .. | 9 25 | 561.30 | ...... | 64.75 | ...... | 216.00 | 41.50 | 166.25 | 142.32 | 248.50 | 1,449.87 | 170 49 |
| Guilford, .. .. .. .. .. | 761.39 | 49.95 | 88.00 | ........ | 82.75 | ........ | ...... | ........ | 133.98 | ........ | 1,124.07 | 139.86 |
| Harwinton, .. .. .. .. | 101.87 | ........ | ...... | ........ | 27.41 | ........ | ...... | 285.65 | 119.00 | 12.82 | 546.75 | ........ |
| Madison,.. .. .. .. .. | 65.30 | 96.89 | 61.00 | ........ | ...... | ........ | ...... | 21.25 | 160.52 | 128.20 | 479.16 | 122.33 |
| Simsbury, .. .. .. .. | 11.29 | 392.21 | 12.00 | 22.75 | ...... | 152.00 | 6 00 | 48.50 | 135.11 | 2.22 | 782.08 | 142.14 |
| Southington,.. .. .. .. | ........ | 495.80 | 50.00 | 62.70 | ...... | 210.00 | 7 00 | 65.65 | 205.98 | 79.00 | 1,176.13 | 179.68 |
| Stafford, .. .. .. .. .. | ........ | 2,795.81 | 192.14 | 325.45 | ...... | 240.00 | 274.75 | 258.55 | ........ | 36.00 | 4,122.70 | 235.95 |
| Union (Monroe, etc.),.. .. | 5.86 | 408.45 | 203.00 | 2.82 | ...... | ........ | 16.25 | 43.50 | ........ | 105.00 | 784.88 | ........ |
| Union (Somers, etc.),.. .. | 61.97 | ........ | 9.00 | ........ | 40.75 | ........ | ...... | 23.00 | 104.78 | ........ | 239.50 | 123.58 |
| Watertown, .. .. .. .. | 307.76 | 1,794.55 | ...... | 72.60 | ...... | 878.00 | 27.00 | 872.00 | 255.12 | 246.50 | 3,458.63 | 283.55 |
| Westbrook, .. .. .. .. | .59 | 98.40 | 61 00 | ........ | ...... | ........ | 3.50 | 1.25 | 138.24 | 200.53 | 503.53 | 113.81 |
| Willimantic, .. .. .. .. | ........ | 2,023 21 | 115.00 | 206.93 | ...... | 396.00 | 40.75 | 316.00 | 240.65 | 172.50 | ........ | 264.92 |
| Wolcott, .. .. .. .. .. | 111.00 | 157.50 | 45.00 | ........ | ...... | ........ | ...... | 55.00 | 121 02 | 113 00 | 602.52 | 131 97 |
| Woodbridge and Bethany, | 23.28 | 119.75 | 73.00 | ........ | ...... | 8.00 | ...... | ........ | 185.67 | 108.75 | ........ | 134.03 |
| Woodstock, .. .. .. .. | 20.16 | 1,291.25 | 152.00 | 89.23 | 10.00 | 91.00 | 72.00 | 173.75 | 284.07 | 243.38 | 2,885.84 | 282 64 |

*$193.79 due Treasurer.

## RETURNS OF AGRICULTURAL SOCIETIES, 1887.—FINANCES, CONTINUED.

| SOCIETIES. | Expenses of Fair. | Premiums for Speed and Amusements. | Other Premiums and Gratuities. | Permanent Improvements. | Other Expenses. | Cash on Hand. | TOTAL. | Indebtedness of Society. | Real Estate. | Personal Estate. | Number of Members. | No. of Stockholders,—Joint Stock. | Capital Stock. | Estimated Attendance. | Admission Tickets. | Season Tickets. | Grand Stand. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Connecticut State, .. .. | $4,375.23 | $1,305.00 | $3,646 75 | $790.98 | [1]$345.75 | $720 86 | $11,184.57 | ........ | ........ | $5,000.00 | 322 | .... | ... .... | 16,800 | $.50 | $1.50 | $ 15 |
| New London County, .. | 1,704.15 | 1,762.50 | 896 13 | 580.35 | 1,750.00 | 137.20 | 6,830.33 | $6,850.00 | $10,000 00 | 300.00 | 325 | .... | ........ | 9,950 | .35 | 1.00 | .15 |
| Fairfield County, .. .. | 1,699 39 | 2,131.00 | 805.00 | 199.18 | 2,350.35 | ....... | 7,189.92 | 10,799.18 | 23,698.01 | ........ | .... | 133 | $30,000.00 | 10,400 | .25 | .... | .25 |
| Windham County, .. .. | 589.25 | 370.00 | 916.85 | 288.31 | ........ | ....... | 2,164 41 | 1,500.00 | 6,000 00 | ........ | 517 | .... | ........ | 9,000 | .25 | .75 | .15 |
| Tolland County, .. .. | 820.51 | 1,176 00 | 569.00 | 551.79 | 464.05 | ...... | ... .... | 1,000.00 | 2,500.00 | ........ | 529 | .... | ...... .. | 11,000 | 25 & 35 | 1.00 | .15 |
| Berlin, .. .. .. .. .. | 71.53 | 76.58 | 239.50 | ........ | 75.51 | 88 69 | 551.81 | ... .... | ....... | 50.00 | 72 | .... | ........ | 1,500 | 10, 15 & 25 | .... | .10 |
| Bristol Park Co., .. .. | 1,656.89 | 335.00 | 920.29 | ........ | ........ | ....... | ........ | 12,000.00 | 17,000.00 | .... . | .... | 328 | 8,694.85 | 5,613 | .25 | .... | .25 |
| Chester, .. .. .. .. | 53.48 | ........ | 230.00 | ........ | ........ | ....... | 283.48 | 107.27 | ....... | 30.00 | 180 | .... | ........ | 1,130 | .10 | .25 | ...... |
| Clinton, .. .. .. .. | 243.62 | ........ | 179.16 | ........ | ........ | 48.70 | 471.48 | ........ | ........ | 70.00 | 122 | .... | ........ | 1,500 | .10 | ... | ...... |
| Danbury, .. .. .. .. | 7,796.82 | 2,882.50 | 3,974.50 | 4,100.00 | ........ | 7,606 90 | 26,360.92 | .00 | 15,000 00 | 3,000.00 | .... | 280 | 12,000.00 | 51,779 | 25 & 15 | 5.00 | 25 & 50 |
| East Granby, .. .. .. | 32.50 | ........ | 176.65 | ........ | ........ | ....... | ........ | ........ | ........ | ........ | 54 | .... | ........ | ...... | ........ | ... | ...... |
| Farmington Valley, .. | 181 73 | 455.00 | 454.70 | 45.84 | 308.00 | 4.80 | ........ | 2,901.04 | 9,190.53 | 40 50 | .... | 71 | 5,000.00 | 2,550 | .25 | .... | .20 |
| Guilford, .. .. .. .. | 80.00 | 30.00 | 295.55 | ........ | ........ | 718.52 | 1,124.07 | ........ | ........ | 75.00 | .... | .... | ........ | 3,000 | ........ | .... | ...... |
| Harwinton, .. .. .. | 131.20 | ........ | 228.45 | ........ | 24.50 | 167 60 | 546.75 | ...... | ....... | ...... . | .... | .... | ........ | 6,000 | ....... | .... | ...... |
| Madison, .. .. .. .. | 263.86 | 3.00 | 212 30 | ........ | ........ | ....... | 479.16 | 13 51 | ........ | ....... | 122 | .... | ........ | 4,000 | .10 | .50 | ...... |
| Simsbury, .. .. .. .. | 135 34 | 340.00 | 312.06 | 2.35 | 20.00 | ....... | 809.75 | ........ | .... ... | 20.00 | 190 | .... | ........ | 2,200 | 25 & 15 | .... | ...... |
| Southington, .. .. .. | 426.90 | 510.00 | 501.00 | 50.00 | ........ | ....... | ....... | 1,000.00 | 7,800 00 | 100.00 | .... | 100 | 7,000.00 | 5,000 | .25 | .... | .15 |
| Stafford, .. .. .. .. | 932 67 | 1,236.50 | 1,287.57 | 194.45 | 152.50 | 319.01 | 4,122.70 | 8,150.00 | 5,000.00 | ... ... | 235 | .... | ....... | 16,000 | .35 | .. . | 10 & 25 |
| Union (Monroe, etc.), .. | 642 93 | 103.00 | 30.00 | 655.07 | ........ | ...... | 1,431.00 | 900 00 | 3,000.00 | 1,000.00 | 163 | .... | ........ | 2,050 | .25 | 1.00 | .10 |
| Union (Somers, etc.), .. | 18.75 | ....... | 218 65 | ....... | ....... | 2.10 | 239.50 | ........ | ........ | 1,400.00 | 350 | ... | .. .... | 3,000 | ........ | .... | ...... |
| Watertown, .. .. .. | 794.81 | 1,066.50 | 1,023 75 | 62.05 | 502.83 | 8.59 | 3,458.53 | 400.00 | 8,500.00 | 125.00 | .... | 152 | 7,000.00 | 9,000 | [2].50 | .... | .25 |
| Westbrook, .. .. .. | 331.19 | ........ | 169.48 | ........ | ........ | 2 86 | 503.53 | 55.00 | ... .... | ........ | 122 | .... | ....... | 2,000 | .10 | .... | ...... |
| Willimantic, .. .. .. | 820.00 | 930.00 | 884.20 | 236.00 | 250.00 | 441.63 | ........ | 8,800.00 | 14,500.00 | ........ | .... | 180 | 10,000.00 | 9,000 | .35 | 1.00 | .15 |
| Woodbridge and Bethany, | 296.18 | 16.00 | 271.25 | ........ | ........ | ...... | ........ | ........ | ........ | ........ | ... | ... | ........ | ...... | .25 | .... | ...... |
| Wolcott, .. .. .. .. | 175.80 | ........ | 260 88 | 5.84 | [3]77 50 | 82.50 | ........ | ........ | ........ | 100.00 | 45 | .... | ........ | 800 | .25 | 1.00 | ...... |
| Woodstock, .. .. .. | 548.44 | 208.00 | 1,019.20 | 313.52 | 180.42 | 121.26 | 2,385.84 | 600.00 | 8,000.00 | 100.00 | 425 | .... | ........ | 6,000 | .25 | .75 | .15 |

[1] Premiums and Medals for Fair of 1886. [2] Entry Ticket, with Ticket for each day of Fair, $1.25. [3] Tent and Transportation.

## ANALYSIS OF PREMIUMS AND GRATUITIES PAID.

### FARM STOCK.

| SOCIETIES. | Bulls. | Milch Cows. | Heifers. | Calves. | Working Oxen. | Steers. | Fat Cattle. | Horses, except Speed. | Sheep. | Swine. | Poultry. | All other Stock. | TOTAL. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Connecticut State, .. .. .. .. | $569.00 | $479.00 | ...... | $101.00 | $137.00 | $64.00 | $29.00 | $400.00 | $501.00 | $60.00 | $249.00 | $59.00* | $2,680.00 |
| New London County, .. .. .. | 44.25 | 175.25 | $73.25 | 22.75 | 56.00 | 12.00 | 17.50 | 176 50 | 90.70 | 21 00 | 21.00 | 32 00 | 782.20 |
| Fairfield County, .. .. .. .. | 25.00 | 16.00 | 25.00 | 14.00 | 27.00 | 12.00 | 21.00 | 67.00 | 39.00 | 9.00 | 75 25 | 52.50 | 882.75 |
| Windham County, .. .. .. .. | 43.00 | 68.00 | 34.00 | 36.00 | 101 00 | 43.00 | 9.00 | 169.00 | 32.00 | 22.00 | 65.00 | ...... | 652.00 |
| Tolland County, .. .. .. .. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 330.00 |
| Berlin,.. .. .. .. .. .. .. | 5.00 | 12.00 | 5.50 | 4.50 | 8.60 | 3.00 | 1.00 | 14.00 | 1.00 | 6 00 | 8.00 | 11.00 | 79.00 |
| Bristol Park Co., .. .. .. .. | 34 32 | 112 45 | 32.43 | 29.15 | 105.10 | 33 85 | 12.15 | 56.50 | 27.00 | 2.00 | 126.48 | 85.05 | 656.48 |
| Chester, .. .. .. .. .. .. | 4.50 | 4.50 | 4.50 | 3 00 | 10.50 | 1.50 | ...... | 11.25 | ...... | 4.00 | 4.45 | ...... | 45 20 |
| Clinton, .. .. .. .. .. .. | 3 85 | 8.75 | 3 20 | 4.35 | 14.00 | 2 75 | 2.00 | 8.75 | 12.25 | 8.00 | 11 38 | ...... | 79.28 |
| Danbury, .. .. .. .. .. .. | 165.00 | 301.00 | 139 00 | 49.00 | 169 00 | 96.50 | 16.00 | 339.00 | 57.00 | 32.00 | 262.00 | 273.00 | 1,898.50 |
| East Granby, .. .. .. .. .. | 4.75 | 77.00 | 8.00 | ...... | 26.00 | 9 00 | ...... | 19.00 | 4.00 | 2.00 | 1.50 | ...... | 151.25 |
| Farmington Valley, .. .. .. | 20.00 | 74 00 | 11.00 | 18.00 | 34.00 | 14.00 | 4 00 | 32.50 | 18.50 | 5.00 | 45.00 | 2.00 | 278.00 |
| Guilford, .. .. .. .. .. .. | 4.50 | 20 00 | 7.00 | 2.00 | 53 00 | 12.50 | ...... | 14.00 | 8.00 | 6.00 | 6.25 | 1.00 | 134.25 |
| Harwinton,.. .. .. .. .. .. | 5.00 | 9.00 | ...... | ...... | 105.90 | ...... | 2.50 | 6.00 | 1.50 | 1.00 | 2 25 | 1.00 | 144.15 |
| Madison, .. .. .. .. .. .. | 2 50 | 15.00 | ...... | 1.75 | 31.00 | ...... | 3.50 | 23.50 | ...... | 11.50 | 21.25 | ...... | 120.00 |
| Simsbury, .. .. .. .. .. .. | 38 00 | 47.00 | 21 25 | 9.75 | 58 00 | 22.25 | ...... | 48.00 | 2.00 | 2.00 | 13.00 | ...... | 261.25 |
| Southington, .. .. .. .. .. | 18.00 | 41.50 | 15.00 | 4.00 | 19.50 | 4.00 | 1.00 | 38.00 | 6.00 | 6.00 | 15.50 | 19.00 | 187.50 |
| Stafford, .. .. .. .. .. .. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ........ |
| Union (Monroe, etc.), .. .. .. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ........ |
| Union (Somers, etc.), .. .. .. | 4.20 | 15.35 | 17.30 | 14.80 | 27.00 | 39 50 | ...... | 26.00 | 2.00 | ...... | 1.50 | ...... | 147.65 |
| Watertown, .. .. .. .. .. .. | 40.00 | 79.00 | 39.00 | 17 00 | 121.00 | 82.00 | 18.00 | 116 00 | 21.00 | 8.00 | 50.00 | 80.00 | 667.25 |
| Westbrook, .. .. .. .. .. .. | 6.50 | 8 12 | 6.30 | 2.43 | 18.20 | 4.55 | 2.60 | 8.61 | 12.97 | 1 30 | 13.88 | ...... | 85.46 |
| Willimantic, .. .. .. .. .. .. | 66.50 | 213 00 | 80.00 | 10.00 | 62.00 | 29.00 | 7.00 | 83.00 | 61.00 | 20 00 | 70.00 | 65.00 | 767.50 |
| Woodbridge and Bethany, .. .. | 4.25 | 8.00 | 9.00 | 3 25 | 25 00 | 1.00 | 9.00 | 35.00 | 6.00 | 7 50 | ...... | ...... | 69.00 |
| Wolcott, .. .. .. .. .. .. | 23.00 | 34.50 | 10.75 | 8.38 | 24.00 | 7.50 | 4.00 | 17.00 | 3.00 | 1.00 | 18.00 | 10.00 | 156.13 |
| Woodstock, .. .. .. .. .. .. | 25.00 | 90 00 | 81.00 | 47.00 | 50.00 | 36.00 | ..... | 178 00 | 24.00 | 23.00 | 32.00 | ...... | 595.00 |

*Discipline.

## ANALYSIS OF PREMIUMS AND GRATUITIES.—CONTINUED.

### FARM PRODUCTS.

| SOCIETIES. | Indian Corn. | Wheat. | Rye. | Barley. | Oats. | Beans. | Grass Seeds. | Potatoes. | Carrots. | Beets. | Parsnips. | Turnips. | Onions. | Other Products. | Total amount for Grain and Root Crops. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Connecticut State, .. .. .. .. | $14.50 | $9.50 | $6.50 | $3.50 | $3.50 | $4 00 | ..... | $54.00 | $6.00 | $7.00 | $1.00 | $3.00 | $5.00 | $22.00 | $140.50 |
| New London County, .. .. .. | 1.25 | ...... | .75 | ...... | .75 | 1.00 | ..... | 5.50 | .75 | 2.25 | ...... | 1.25 | ...... | ...... | 13.50 |
| Fairfield County, .. .. .. .. | 7.00 | 1.50 | 1.50 | ...... | .50 | ..... | $7.00 | 4.50 | 1.50 | 2.50 | 1.50 | ...... | 4.50 | 1.00 | 33.00 |
| Windham County, .. .. .. .. | 2.75 | ...... | 1.50 | 1.00 | 1.75 | 3.00 | ..... | 9.00 | .75 | 1.75 | .75 | 1.50 | 1.50 | 15.25 | 40.50 |
| Tolland County, .. .. .. .. | ...... | ...... | ...... | ...... | ...... | ..... | ..... | ...... | ..... | ...... | ...... | ...... | ...... | ...... | 16.25 |
| Berlin, .. .. .. .. .. .. .. | 14.50 | 8.00 | 3.00 | ...... | 1.50 | 8.50 | ..... | 20.25 | 3.00 | 5.00 | 1.25 | 5 25 | 2.50 | 18.75 | 76 50 |
| Bristol Park Co., .. .. .. .. | 6.50 | 1.00 | 1.00 | .75 | 2.00 | 1.00 | 1.50 | 10.25 | 1.25 | 1.50 | .25 | 1.25 | .75 | .75 | 29.75 |
| Chester, .. .. .. .. .. .. | 18.20 | ...... | 1.00 | ...... | 2.20 | 2.05 | ..... | 13.50 | 1.70 | 3.30 | ...... | 3 90 | 2 50 | 64.95 | 113 30 |
| Clinton, .. .. .. .. .. .. | 7.35 | ...... | .15 | .30 | .15 | 1.28 | ..... | 3.78 | .40 | 1.10 | ...... | 1.20 | .80 | ...... | 16.46 |
| Danbury, .. .. .. .. .. .. | 8.50 | 3.50 | 3.50 | ...... | 5.50 | 2.50 | 3 00 | 61.75 | 8.13 | 5.25 | 1.25 | 17.00 | 8.00 | 41.75 | 164.63 |
| East Granby, .. .. .. .. .. | 2.00 | ...... | .50 | ...... | ...... | ..... | ..... | .75 | .25 | ...... | ...... | ...... | ...... | ...... | 3.50 |
| Farmington Valley, .. .. .. | 5.00 | .50 | .75 | 1.50 | .75 | 2.25 | ..... | 16.00 | .50 | 1.50 | .50 | .75 | 1.50 | ...... | 31.50 |
| Guilford, .. .. .. .. .. .. | 12.25 | 1.00 | 1.00 | ...... | .75 | 1.55 | ..... | 10 00 | ..... | ...... | ...... | 5.00 | 2.25 | 7.00 | 40.80 |
| Harwinton, .. .. .. .. .. | 1.00 | .50 | .50 | .25 | .80 | .80 | ..... | 2.75 | ..... | ...... | .80 | 1.00 | .50 | ...... | 8.90 |
| Madison, .. .. .. .. .. .. | 2.50 | ...... | .40 | ...... | ...... | .50 | ..... | 3 40 | .40 | 1.05 | ...... | 1.20 | 2.45 | 9.95 | 21.85 |
| Simsbury, .. .. .. .. .. .. | 2.25 | ...... | ..... | ...... | ...... | .50 | ..... | 1.25 | ..... | .50 | ...... | 1.00 | 1.50 | 2.00 | 9.00 |
| Southington, .. .. .. .. .. | 9.00 | ...... | 1.50 | .50 | 2.00 | 2.00 | ..... | 18.75 | 3.75 | 3.50 | .75 | 3.50 | 5.50 | . 21 00 | 71.75 |
| Stafford, .. .. .. .. .. .. | ...... | ...... | ...... | ...... | ...... | ..... | ..... | ...... | ..... | ...... | ...... | ...... | ...... | ...... | ...... |
| Union (Monroe, etc.), .. .. .. | ...... | ...... | ...... | ...... | ...... | ..... | ..... | ...... | ..... | ...... | ...... | ...... | ...... | ...... | ...... |
| Union (Somers, etc.), .. .. .. | 1.25 | .75 | ...... | ...... | ...... | ..... | ..... | 10.50 | ..... | ...... | ...... | ...... | 2.25 | ...... | 14.75 |
| Watertown, .. .. .. .. .. | 3.25 | ...... | 1.00 | ...... | .75 | 1.25 | ..... | 15.00 | .75 | 1.25 | .50 | 1.50 | 16 25 | ...... | 41.50 |
| Westbrook, .. .. .. .. .. | 5.52 | ...... | .65 | .16 | .32 | .29 | ..... | 6 47 | .16 | .58 | .16 | .32 | 1.62 | ...... | 16.25 |
| Willimantic, .. .. .. .. .. | 1.25 | 1.25 | 1.25 | ...... | 1.25 | 2.50 | ..... | 6.00 | .50 | 1 50 | .50 | 2.50 | 2.75 | 2.00 | 23.25 |
| Woodbridge and Bethany, .. .. | 9.00 | .75 | 1.25 | ...... | .75 | ..... | ..... | 8 75 | .25 | 2.25 | ...... | 2.00 | .75 | ...... | 25.75 |
| Wolcott. .. .. .. .. .. .. | 8 75 | ...... | .50 | ...... | .50 | ..... | ..... | 17.75 | .50 | 2.00 | .50 | 2.50 | ...... | ...... | 28.00 |
| Woodstock, .. .. .. .. .. | 6.50 | ...... | 1.50 | 1.00 | 1.00 | 2.00 | ..... | 9.50 | 1.75 | 3.25 | ...... | 2.25 | 1.50 | 8.00 | 38.25 |

## ANALYSIS OF PREMIUMS AND GRATUITIES.—CONTINUED.

## FARM PRODUCTS.

| SOCIETIES. | Fruits. | Flowers. | Other Cult. Crops. | Butter. | Cheese. | Honey and Wax. | Bread and Cake. | Sugar, Syrup, Preserved Fruit. | Grange Exhibit. | Agricultural Implements. | Mechanical Inventions. | Fine Arts and Fancy Articles. | Decorated Carts and Trains of Oxen. | Plowing at Exhibition. | Medals. | Diplomas. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Connecticut State, | $311.00 | $50.00 | $10.00 | $25.00 | $8.00 | $6.00 | $29.00 | $5.00 | $305.00 | $320.00 | $80.00 | $268.00 | $20.00 | $30.00 | 42 | 93 |
| New London County, | 25.10 | 14.50 | 10.75 | 10.50 | 8.25 | .75 | 6 00 | .50 | ...... | 24.00 | 57.00 | 38 25 | ...... | ...... | .. | 12 |
| Fairfield County, | 95 50 | 44.75 | 39.50 | 3.00 | ...... | 1.00 | 6.25 | 10.00 | ...... | 7.50 | 44.75 | 137.00 | ...... | ...... | .. | 31 |
| Windham County, | 63 50 | 30.25 | ...... | 10.00 | 10.00 | 3.00 | 7.50 | 7.00 | ...... | ...... | 34.60 | 68.50 | ...... | ...... | .. | 15 |
| Tolland County, | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 135.00 | ...... | ...... | 25 25 | ...... | ...... | .. | 21 |
| Berlin, | 33 00 | 6.50 | ...... | 12.50 | 3.00 | ..... | 10.00 | ...... | ...... | ...... | ...... | 14.00 | 5.00 | ..... | 18 | .. |
| Bristol Park Co., | 52.50 | 6.25 | 8.67 | 1.25 | .50 | 1.25 | 10.50 | 13 75 | 35.00 | 8.75 | 46.77 | 23 25 | 25.55 | ...... | 10 | .. |
| Chester, | 18.00 | 1 50 | ...... | .90 | ...... | .80 | 5.60 | 15.00 | ...... | ...... | 5.00 | 24.70 | ...... | ...... | .. | .. |
| Clinton, | 16.80 | 2.00 | 1.10 | .88 | ...... | .48 | 6.40 | 3.75 | ...... | 1.90 | 10.95 | .60 | 33.25 | ...... | .. | 4 |
| Danbury, | 253.75 | 118.50 | 27.50 | 3.50 | .50 | 2.00 | 72.00 | 50.25 | ...... | ...... | 453.25 | 795.62 | 139.50 | ...... | .. | 94 |
| East Granby, | 8.50 | .25 | .25 | ...... | .50 | ...... | .50 | 1.00 | ...... | ...... | 1.25 | 9.65 | ...... | ...... | .. | .. |
| Farmington Valley, | 31.25 | ...... | 22.00 | 5.00 | .50 | .30 | 14.25 | 4.05 | 35.00 | ...... | ...... | 32.85 | ...... | ...... | .. | .. |
| Guilford, | 59.00 | 3.75 | ...... | 9.50 | ...... | 1.50 | 13 50 | 2.00 | ...... | ...... | 15.00 | 11.25 | 5 00 | ...... | .. | .. |
| Harwinton, | 4.40 | 1.50 | 3.00 | 1.00 | 1.00 | ...... | 2 00 | .50 | ...... | ...... | 9.00 | 2.00 | 46.00 | ...... | .. | .. |
| Madison, | 5.65 | 1.30 | ...... | .75 | ...... | .50 | 3.70 | 5.25 | ...... | ...... | 2.75 | 13.00 | 37.75 | ...... | .. | .. |
| Simsbury, | 5.75 | 3.25 | 10.00 | 4.00 | ...... | 2.00 | 5 00 | 4.81 | ...... | ...... | 2.00 | 5.00 | ...... | ...... | .. | .. |
| Southington, | 58.50 | 5.75 | 25.00 | 3.00 | ...... | .75 | 19.50 | 5.50 | ...... | ...... | ...... | 101.25 | 22.00 | ...... | .. | .. |
| Stafford, | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 260.00 | ...... | .. | .. |
| Union (Monroe, etc.), | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | .. | .. |
| *Union (Somers, etc ), | 13.50 | ...... | ...... | 3 25 | .75 | ...... | 2.00 | 2.75 | ...... | 2 00 | 3.00 | 15.00 | ...... | ...... | .. | .. |
| Watertown, | 35.25 | 19.25 | ...... | 3.00 | 2.00 | .50 | 13.75 | 10 25 | ...... | 16.25 | 80.00 | 86.75 | 33.00 | ...... | 4 | .. |
| Westbrook, | 11.53 | 1.30 | 6.18 | ...... | ...... | .32 | 6.30 | 7 44 | ...... | .16 | ...... | 15.74 | 18.85 | ...... | .. | .. |
| Willimantic, | 25.50 | 4.75 | ...... | 5.50 | 5.75 | 3.00 | ...... | ...... | ...... | 9.00 | 15.00 | 30.35 | ...... | ...... | .. | 49 |
| Woodbridge and Bethany, | 43.50 | 8.50 | ...... | 1.50 | 1.50 | .50 | 2 00 | ...... | ...... | 6 00 | 4.75 | 13.75 | 33.00 | ...... | .. | .. |
| Wolcott, | 15.75 | 1.00 | 1.50 | 1.50 | 1.00 | ...... | 4.00 | 1.50 | ...... | 4 00 | ...... | 18.75 | 28.00 | ...... | .. | .. |
| Woodstock, | 46.50 | 44.00 | 31.75 | 6.00 | 6.00 | 1.50 | 7.00 | 5 50 | ...... | 21.50 | 96.75 | 13.70 | 63 00 | 48.00 | .. | .. |

* Management of Farms, $15.00.

## NUMBER OF ANIMALS EXHIBITED.

| SOCIETIES. | Bulls. | Milch Cows. | Heifers. | Calves. | Working Oxen (pairs). | Steers (pairs). | Fat Cattle. | Horses — except speed. | Horses — speed. | Sheep. | Swine. | Poultry (coops). | All other Stock. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Connecticut State,.. | 68 | 201 | .. | 94 | 53 | 30 | 23 | 108 | 60 | 311 | 15 | 244 | .. |
| New London County, | 17 | 94 | 66 | 23 | 39 | 6 | 14 | 88 | .. | 145 | 25 | 35 | 83 |
| Fairfield County, .. | 6 | 11 | 14 | 10 | 10 | 3 | 8 | 39 | .. | 28 | 19 | 93 | .. |
| Windham County, .. | 21 | 61 | 41 | 55 | 58 | 40 | 5 | 60 | 24 | 76 | 68 | 81 | .. |
| Tolland County, .. | 5 | 85 | .. | .. | 121 | 8 | .. | 45 | 21 | .. | .. | 54 | .. |
| Berlin,.. | 8 | 8 | 7 | 7 | 6 | 2 | 1 | 8 | .. | 4 | 7 | 19 | .. |
| Bristol Park Co., | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Chester, | 2 | 10 | 10 | 11 | 25 | 2 | .. | 9 | .. | .. | 2 | 15 | .. |
| Clinton, | 10 | 28 | 15 | 16 | 25 | 10 | 10 | 20 | .. | 90 | 12 | 60 | .. |
| Danbury, .. | 34 | 67 | 80 | 48 | 56 | 83 | 10 | 89 | 39 | 48 | 12 | 448 | 107 |
| East Granby, .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Farmington Valley, | 18 | 58 | 30 | 20 | 10 | 11 | 3 | 21 | 20 | 36 | 18 | 61 | .. |
| Guilford, .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Harwinton, | 7 | 12 | .. | .. | 120 | .. | 8 | 6 | .. | 12 | 1 | 6 | .. |
| Madison, .. | 6 | 17 | .. | 4 | 19 | .. | 5 | 15 | .. | .. | 9 | 47 | .. |
| Simsbury, .. | 17 | 16 | 13 | 16 | 32 | 22 | .. | 10 | 18 | 6 | 7 | 28 | .. |
| Southington, .. | 8 | 31 | 13 | 5 | 50 | 10 | 2 | 20 | .. | 14 | 2 | 18 | .. |
| Stafford, .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Union (Monroe, etc.), | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Union (Somers, etc.), | 4 | 29 | 22 | 26 | 40 | 29 | .. | 30 | .. | 8 | .. | 2 | .. |
| Watertown, | 20 | 75 | 44 | 25 | 150 | 120 | 10 | 78 | 21 | 44 | 24 | 50 | 90 |
| Westbrook, | 7 | 38 | 16 | 9 | 21 | 6 | 7 | 23 | .. | 68 | 8 | 73 | .. |
| Willimantic, .. | 37 | 100 | 40 | 15 | 82 | 30 | 10 | 77 | 30 | 230 | 45 | 59 | .. |
| Woodbridge and Bethany,.. | 3 | 4 | 5 | 4 | 10 | 1 | 6 | 15 | 3 | 12 | .. | .. | .. |
| Wolcott, .. | 11 | 45 | 9 | 15 | 25 | 17 | 7 | 14 | .. | 11 | 8 | 52 | .. |
| Woodstock, | 20 | 30 | 48 | 41 | 60 | 36 | .. | 101 | 21 | 26 | 36 | 124 | .. |

NOTE.—The Connecticut State and many other societies fail to report the number of working oxen in teams.

## AGRICULTURAL FAIRS IN CONNECTICUT, 1887.

| NAME. | PLACE. | DATE. | ATTENDANCE. | | | | |
|---|---|---|---|---|---|---|---|
| | | | Tuesday. | Wednesday. | Thursday. | Friday. | Saturday. |
| Connecticut State, | Meriden, | Sept. 13-16, | 2,800 | 5,000 | 7,000 | 2,000 | ..... |
| New London County, | Norwich, | Sept. 20-22, | 450 | 8,000 | ..... | 1,500 | ..... |
| Fairfield County, | Norwalk, | Sept. 20-23, | 400 | 2,000 | 5,000 | 3,000 | ..... |
| Windham County, | Brooklyn, | Sept. 20-22, | 1,000 | 5,000 | 3,000 | ..... | ..... |
| Tolland County, | Rockville, | Oct. 4-6, | 2,000 | 3,000 | 6,000 | ..... | ..... |
| Berlin, | Berlin, | Oct. 5, | ..... | 1,500 | ..... | ..... | ..... |
| Bristol Park Co., | Bristol, | Sept. 26-Oct. 1, | ..... | ..... | ..... | ..... | ..... |
| Chester, | Chester, | Oct. 6, | ..... | ..... | 1,130 | ..... | ..... |
| Clinton, | Clinton, | Oct. 11, | ..... | 1,500 | ..... | ..... | ..... |
| Danbury, | Danbury, | Oct. 4-8, | 2,847 | 7,336 | 19,637 | 17,464 | 4,795 |
| East Granby, | East Granby, | .......... | ..... | ..... | ..... | ..... | ..... |
| Farmington Valley, | Collinsville, | Sept. 21-22, | ..... | 1,200 | 1,350 | ..... | ..... |
| Guilford, | Guilford, | Sept. 28, | ..... | 3,000 | ..... | ..... | ..... |
| Harwinton, | Harwinton, | Oct. 4, | 6,000 | ..... | ..... | ..... | ..... |
| Madison, | Madison, | Oct. 13, | ..... | ..... | 4,000 | ..... | ..... |
| Simsbury, | Simsbury, | Sept. 29-30, | ..... | ..... | 700 | 1,500 | ..... |
| Southington, | Southington, | Sept. 27-29, | 1,000 | 1,500 | ..... | ..... | ..... |
| Stafford, | Stafford Springs, | Oct. 12-13, | ..... | ..... | ..... | ..... | ..... |
| Union (Monroe, etc.), | Huntington, | Oct. 5-6, | ..... | 1,300 | 750 | ..... | ..... |
| Union (Somers, etc.), | Ellington, | Sept. 28, | ..... | 3,000 | ..... | ..... | ..... |
| Watertown, | Watertown, | Sept. 20-22, | 3,000 | 3,500 | ..... | 2,500 | ..... |
| Westbrook, | Westbrook, | Oct. 4-5, | 1,500 | 500 | ..... | ..... | ..... |
| Willimantic, | Willimantic, | Sept. 27-29, | 2,000 | 7,000 | ..... | .... | ..... |
| Woodbridge and Bethany, | Woodbridge, | Sept. 28, | ..... | ..... | ..... | ..... | ..... |
| Woodstock, | South Woodstock, | Sept. 14-15, | ..... | 2,750 | 3,250 | ..... | ..... |
| Wolcott, | Wolcott, | Oct. 12, | ..... | 800 | ..... | ..... | ..... |

## OFFICIAL LIST OF FARMERS' CLUBS IN CONNECTICUT, 1887-8.

| NAME OF CLUB. | PRESIDENT. | SECRETARY. |
|---|---|---|
| New Haven County,... | Prof. Wm. H. Brewer, | Cullen B. Foote. |
| Bristol,................ | S. R. Gridley,........ | J. M. Peck. |
| Cheshire,.............. | E. A. Atwater,....... | Edgar Beadle. |
| Chester,............... | A. H. Gilbert,........ | C. E. Lord. |
| Columbia,............. | Joseph Hutchins,.... | W. H. Yeomans. |
| East Windsor,.......... | William H. Barber,... | John F. Fitts |
| Green's Farms,......... | J. H. Jennings,...... | S. B. Sherwood. |
| Middlefield,............ | H. W. Hurlburt,..... | P. M. Augur. |
| Morris,................. | A. C. Tracy,......... | S. W. S. Skilton. |
| Mystic,................. | Josiah Hammond,.... | James Watrous, Jr. |
| Naugatuck,............ | J. B. Tolles,.......... | M. S. Baldwin. |
| Newington,............ | H. A. Whittlesey,.... | J. S. Kirkham. |
| New Britain,........... | L. S. Wells,.......... | A. C. Blake. |
| Pomfret,............... | C. D. Williams,...... | B. S. Warner. |
| South Coventry,........ | P. H. Peterson,...... | M. Parker. |
| Tunxis,................ | A. Porter,........... | E. C. Ayer. |
| Watertown,............ | S. H. Peck,.......... | H. M. Hickox. |
| West Cornwall,......... | H. C. Hart,.......... | T. S. Gold. |
| Willimantic,............ | David H. Jacobs,.... | N. P. Perkins. |
| Wilton,................ | D. N. Van Hoosear,.. | J. C. Dudley. |

### CONNECTICUT DAIRYMEN'S ASSOCIATION.

William M. Wadsworth, *President.* J. S. Kirkham, *Secretary.*

### HARTFORD COUNTY HORTICULTURAL SOCIETY.

E. B. Smead, *President.* Dr. E. E. Case, *Secretary.*

### WESTERN CONNECTICUT POULTRY ASSOCIATION.

Gilbert L. Hart, *President.* John D. Adams, *Secretary.*

### MERIDEN POULTRY ASSOCIATION.

L. E. Coe, *President.* H. Dryhurst, *Secretary.*

### NEW HAVEN POULTRY ASSOCIATION.

J. B. Robertson, Jr., *President.* Geo. F. Howard, *Secretary.*

# GRANGE DIRECTORY.

| Master. | Secretary. |
|---|---|
| **CONNECTICUT STATE.** | |
| J. H. Hale, South Glastonbury. | Lewis J. Wells, South Woodstock. |
| **CENTRAL POMONA, No. 1.** | |
| J. M. Hubbard, Middletown. | C. P. Ives, Meriden. |
| **QUINNEBAUG POMONA, No. 2.** | |
| L. J. Wells, South Woodstock. | Monroe Latham, Eastford. |
| **EAST CENTRAL POMONA, No. 3.** | |
| John Thompson, Ellington. | Mrs. Robert Walker, Vernon Center. |
| **MOUNTAIN COUNTY POMONA, No. 4.** | |
| Tunis Goodenough, Burrville. | Weston Barnes, Collinsville. |
| **TUNXIS, No. 13.** | |
| Henry C. Cadwell, Bloomfield. | F. B. Miller, Bloomfield. |
| **HOPE, No. 20.** | |
| A. F. Miner, Torrington. | B. C. Patterson, Torrington. |
| **LEBANON, No. 21.** | |
| C. H. Peckham, Yantic. | N. S. Loomis, Lebanon. |
| **ADVANCE, No. 22.** | |
| N. W. Holcomb, West Simsbury. | J. C. Eddy, Simsbury. |
| **CHESHIRE, No. 23.** | |
| J. Norris Barnes, West Cheshire. | Fred. A. Ives, West Cheshire. |
| **BERLIN, No. 24.** | |
| H. E. Savage, East Berlin, | Earl Cooley, Berlin. |
| **UNION, No. 25.** | |
| C. W. Blatchley, Plantsville. | John J. Barnes, Southington. |
| **GLASTONBURY, No. 26.** | |
| H. E. Loomis, Glastonbury. | James H. Tryon, So. Glastonbury. |
| **SUFFIELD, No. 27.** | |
| Geo. A. Austin, Suffield. | H. A. Henshaw, Suffield. |
| **SOUTH WINDSOR, No. 28.** | |
| H. B. Noble, South Windsor. | E. A. Farnham, South Windsor. |
| **MERIDEN, No. 29.** | |
| George B. Murdock, Meriden. | Lyman H. Francis, Meriden. |
| **WAPPING, No. 30.** | |
| N. F. Stoughton, Wapping. | Ralph M. Grant, Wapping. |

| Master. | Secretary. |
|---|---|
| **MANCHESTER, No. 31.** | |
| J. B. Olcott, South Manchester. | F. N. Buckland, Burnside. |
| **NORTH CORNWALL, No. 32.** | |
| T. S. Gold, West Cornwall. | Horace C. Hart, West Cornwall. |
| **WALLINGFORD, No. 33.** | |
| Geo. A. Hopson, E. Wallingford. | F. M. Bartholomew, E. Wallingford. |
| **CAWASA, No. 34.** | |
| G. C. Beckwith, Nepaug. | S. F. Lewis, Collinsville. |
| **NORTH HAVEN, No. 35.** | |
| J. E. Bishop, Clintonville. | James S. Bishop, Clintonville. |
| **LITTLE RIVER, No. 36.** | |
| W. H. Hammond, Elliott. | Mrs. Joseph W. Clark, Hampton. |
| **EAST HARTFORD, No. 37.** | |
| Charles W. Roberts, E. Hartford. | Charles R. Risley, East Hartford. |
| **NEW CANAAN, No. 38.** | |
| Fred. M. Hawley, New Canaan. | Darius A. St. John, New Canaan. |
| **BURRITT, No. 39.** | |
| H. F. Wells, New Britain. | Arthur C. Blake, New Britain. |
| **SENEXET, No. 40.** | |
| H. W. Hibbard, Woodstock. | C. C. Gildersleeve, E. Woodstock. |
| **KONOMOC, No. 41.** | |
| W. E. Kenyon, New London. | E. J. Hempstead, New London. |
| **MATTABESETT, No. 42.** | |
| Richard Davis, Middletown. | Chas. H. Williams, Middletown. |
| **BROOKLYN, No. 43.** | |
| Chas. W. Snow, Brooklyn. | Miss Hattie Cox, Brooklyn. |
| **NEWINGTON, No. 44.** | |
| H. A. Whittlesey, Newington. | Lizzie A. Root, Newington. |
| **HARWINTON, No. 45.** | |
| Albert G. Wilson, Harwinton. | Eugene W. Hinman, Torrington. |
| **ELLINGTON, No. 46.** | |
| Chas. B. Sikes, Sr., Ellington. | Alfred A. Stevens, Rockville. |
| **BOLTON, No. 47.** | |
| Wm. C. White, Andover. | W. E. Alvord, Bolton. |
| **WHIGVILLE, No. 48.** | |
| L. B. Pond, Unionville. | L. L. Lowrey, Bristol. |
| **FARMINGTON, No. 49.** | |
| A. R. Wadsworth, Farmington. | H. L. Crandall, Farmington. |

|  | Master. | Secretary. |
|---|---|---|
| Westfield, No. 50. | Rev. G. Henry Smith, Little River. | F. E. Boardman, Little River. |
| Tolland, No. 51. | J. H. Clough, Tolland. | Miss Annie L. Meacham, Rockville. |
| Vernon, No. 52. | E. H. Lathrop, Vernon Center. | J. B. Brown, Vernon Center. |
| Poquonock, No. 53. | E. S. Hough, Poquonock. | Albert H. Clark, Poquonock. |
| Plainville, No. 54. | R. A. Potter, Plainville. | George Cook, Plainville. |
| Stafford, No. 55. | D. J. Glazier, West Stafford. | H. A. Glazier, West Stafford. |
| East Haddam, No. 56. | Almon Day, Hadlyme. | Robert W. Bingham, East Haddam. |
| Durham, No. 57. | Arthur H. Merwin, Durham. | Wilbur J. Davis, Durham Center. |
| West Hartford, No. 58. | Timothy Sedgwick, W. Hartford. | C. A. Griswold, West Hartford. |
| Saybrook, No. 59. | Sam'l A. Chalker, Saybrook. | John N. Clark, Saybrook. |
| Crystal Lake, No. 60. | S. O. Bowen, Eastford. | O. H. Hiscox, Woodstock Valley. |
| Wolf Den, No. 61. | Charles O. Thompson, Pomfret. | William D. Fay, Elliot. |
| Eureka, No. 62. | Chas. G. Rood, New Hartford. | R. C. Brown, Nepaug. |
| Middlefield, No. 63. | Edwin P. Augur, Middlefield. | Alfred H. Augur, Middlefield. |
| Mansfield, No. 64. | L. P. Chamberlain, Mansfield. | H. B. Hubbard, Mansfield. |
| Quinnatisset, No. 65. | G. A. Hawkins, Putnam. | H. S. Morse, Thompson. |
| Killingworth, No. 66. | Nathan H. Evarts, Killingworth. | C. D. Evarts, Killingworth. |
| Cromwell, No. 67. | Caleb S. Pease, Cromwell. | Geo. S. Butler, Cromwell. |
| Natchaug, No. 68. | Chas. H. Spafford, No. Windham. | Chas. B. Russ, Chaplin. |

| Master. | Secretary. |
|---|---|
| **SHETUCKET, No. 69.** | |
| A. E. Weldon, Scotland. | Caleb Anthony, Scotland. |
| **CANTERBURY, No. 70.** | |
| Geo. T. Sanger, Canterbury. | Marvin H. Sanger, Canterbury. |
| **MAD RIVER, No. 71.** | |
| A. B. Pierpont, Waterbury. | J. I. Byam, Waterbury. |
| **PLYMOUTH, No. 72.** | |
| Wallace E. Dayton, Plymouth. | Ard Welton, Plymouth. |
| **INDIAN RIVER, No. 73.** | |
| Henry C. Miles, Milford. | S. E. Frisbie, Milford. |
| **WINCHESTER, No. 74.** | |
| Tunis Goodenough, Burrville. | S. A. Wetmore, Winchester. |
| **COVENTRY, No. 75.** | |
| Wm. C. Havens, Coventry. | Etta M. Loomis, Coventry. |
| **ANDOVER, No. 76.** | |
| Wm. B. Sprague, Andover. | E. Y. Yeomans, Andover. |
| **CLINTON, No. 77.** | |
| Geo. H. Brooks, Clinton. | Samuel S. Wilcox, Clinton. |
| **COLCHESTER, No. 78.** | |
| D. S. Bigelow, Westchester. | W. P. Adams, Westchester. |
| **HOUSATONIC, No. 79.** | |
| S. C. Lewis, Stratford. | C. W. Curtiss, Stratford. |
| **GUILFORD, No. 80.** | |
| William H. Lee, Guilford. | John W. Norton, Guilford. |

# TREASURER'S REPORT.

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**John S. Kirkham**, Treasurer, *in account with*
**The Connecticut Board of Agriculture.**

### RECEIVED.

| | | |
|---|---|---|
| March 1, 1887, | Balance from last Report, | $55.92 |
| January 3, 1888, | From State Treasurer, | 3,500.00 |
| | | $3,555.92 |

### PAID.

| | | | |
|---|---|---|---|
| T. S. Gold, | Salary, | $700.00 | |
| | Traveling expenses, | 249.32 | |
| | Express and freight, | 25.91 | |
| | Postage, | 62.60 | |
| | Telegrams, | 3.50 | |
| | Stationery, | 5.40 | |
| | Strawberry show, | 14.75 | |
| | Stamford Advocate (adv.), | 1.00 | |
| | Bridgeport Standard (printing), | 7.00 | |
| | Hotel bill at farmers' convention, | 137.25 | |
| | Sundry expenses, | 13.95 | |
| | Expense of board, August 23d, | 2.20 | |
| | James B. Olcott, | 48.00 | |
| | Prof. H. E. Alvord, | 30.00 | |
| | Prof. A. T. Hadley, | 26.25 | |
| | Prof. W. H. Brewer, | 26.25 | |
| | Prof. W. O. Atwater, | 26.00 | |
| | J. M. Hubbard, | 25.00 | |
| | Miss Frances E. Burr, | 25.00 | |
| | R. S. Hinman, | 10.00 | |
| | B. G. Northrop, | 3.00 | |
| | Subscription to Medical Journal, | 2.00 | |
| | U. S. publications list, | 5.00 | |
| | Dr. Noah Cressy, | 25.00 | |
| | | | $1,474.38 |
| George P. Rowell & Co. (adv.), | | | 20.35 |
| Phelps Publishing Co. (adv.), | | | 6.00 |
| Luther Tucker & Son (adv.), | | | 8.40 |
| Connecticut Farmer (adv.), | | | 2.25 |

| | |
|---|---|
| E. H. Lathrop, | $10.18 |
| A. Mugford (engraver), | 64.50 |
| William G. French, | 12.68 |
| Dr. J. E. Gardner, | 37.00 |
| Dr. A. D. Sturges, | 10.00 |
| P. M. Augur, | 125.99 |
| B. D. Norris, | 30.00 |
| Dr. Noah Cressy, | 78.41 |
| Dr. J. W. Alsop, | 4.89 |
| The Case, Lockwood & Brainard Co., | 231.48 |
| John S. Kirkham, | 38.08 |
| E. H. Hyde, | 462.07 |
| H. Larrabee, | 43.00 |
| William D. Holman, | 22.00 |
| J. P. Barstow, | 16.22 |
| Albert Day, | 41.75 |
| James A. Bill, | 38.00 |
| J. M. Hubbard, | 9.30 |
| Dennis Fenn, | 22.40 |
| W. H. Dodd & Co., | 100.00 |
| J. M. W. Yerrinton, | 152.75 |
| J. H. Hale, | 2.75 |
| Balance in Treasury March 1, 1888, | 491.09 |
| | $3,555.92 |

STATE OF CONNECTICUT.

# ANNUAL REPORT

OF

# The Connecticut Agricultural

# EXPERIMENT STATION

For 1887.

**PRINTED BY ORDER OF THE GENERAL ASSEMBLY.**

NEW HAVEN, CONN.:
TUTTLE, MOREHOUSE & TAYLOR, PRINTERS.
1888.

THE

# Connecticut Agricultural Experiment Station.

## OFFICERS FOR 1887.

### STATE BOARD OF CONTROL.

*Ex-officio.*

HIS EXC. PHINEAS C. LOUNSBURY, *President.*

*Appointed by Connecticut State Agricultural Society:* **Term expires**

HON. E. H. HYDE, Stafford, *Vice-President.* July 1, 1891.

*Appointed by Board of Trustees of Wesleyan University:*

PROF. W. O. ATWATER, Middletown. 1888.

*Appointed by Governor and Senate:*

EDWIN HOYT, New Canaan. 1889.
H. L. DUDLEY, New London. 1890.

*Appointed by Board of Agriculture:*

*Executive Committee.*

T. S. GOLD, West Cornwall. 1889.

*Appointed by Governing Board of Sheffield Scientific School:*

W. H. BREWER, New Haven, *Secretary and Treas.* 1890.

*Ex-officio.*

S. W. JOHNSON, New Haven, *Director.*

---

*Chemists.*

E. H. JENKINS, PH.D., *Vice-Director.*
E. H. FARRINGTON, B.S.
A. L. WINTON, JR., PH.B.
T. B. OSBORNE, PH.D.

*In charge of Buildings and Grounds.*

CHARLES J. RICE.

# ANNOUNCEMENT.

The Connecticut Agricultural Experiment Station was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, soils, milk, and other agricultural materials and products, to identify grasses, weeds, and useful or injurious insects, and to give information on various subjects of Agricultural Science, for the use and advantage of the citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, etc., etc., for the citizens of Connecticut, without charge, provided—

1. That the results are of use to the public and are free to publish.
2. That the samples are taken from stock now in the market, and in accordance with the Station instructions for sampling.
3. That the samples are fully described and retail prices given on the Station "Forms for Description."

All other work proper to the Experiment Station that can be used for the public benefit will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 23.

Results of analysis or investigation that are of general interest will be published in Bulletins, of which copies are sent to each Post Office in this State, and will be summed up in the Annual Reports made to the Legislature.

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of the farmers is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in duly authenticated samples early during each season of trade.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties, sent on application.

☞ Parcels by Express, to receive attention, should be *prepaid*, and all communications should be directed, *not to any individual officer*, but simply to the

AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN, CONN.

☞ Station Grounds, Laboratory and Office are on Suburban st., between Whitney avenue and Prospect st., 1⅜ miles North of City Hall. Suburban st. may be reached by the Whitney ave. Horse Cars, which leave the corner of Chapel and Church sts. three times hourly, viz., on the striking of the clock and at intervals of twenty minutes thereafter.

☞ The Station has Telephone connection and may be spoken from the Central Telephone Office, 346 State st., or from Peck and Bishop's Office in Union R. R. Depot.

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# REPORT OF THE BOARD OF CONTROL.

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*To His Excellency, Phineas C. Lounsbury, Governor of Connecticut:*

In accordance with the law establishing the CONNECTICUT AGRICULTURAL EXPERIMENT STATION, as amended by Chapter V, Sec. 20 of the acts of the last General Assembly, the Board of Control herewith submits its Annual Report. The Report of the Director will show that the work of the Station has gone on without interruption during the twelve-month just completed. Two hundred and ninety analyses of fertilizers, twenty-two of feeding stuffs, eight of potatoes, eight of insecticides and a number of analyses of miscellaneous articles will be included in his Report, and a large amount of efficient work has been done besides, in testing and improving methods and appliances for the analysis of fertilizers, soils, and feeding stuffs. The chemical work required by the Dairy Commissioner has been done at the Station. A field experiment has been carried out to test the agricultural value of certain phosphates, and a Forage Garden on the Station grounds has been established for the study of problems connected with the improvement of meadows and pastures. These subjects will be fully discussed in the Report of the Director which is in an advanced state of preparation, and will be ready for publication early in 1888. The Report of the Treasurer herewith presented exhibits the financial affairs of the Station for the last fiscal year. The Board of Control has held one special meeting relating to the Experiment Station bill which was passed by the 49th Congress and the Executive Committee has also held two meetings. The Board appointed delegates to a National Convention of representatives of Agricultural Colleges and Experiment Stations held in Washington, Nov. 22–24, called for the purpose of concerting measures to remedy a defect in that bill which failed to provide the special appropriation it was intended to make. It is now confidently expected that funds from this source will shortly be available for the use of this Station.

All which is respectfully submitted:

WM. H. BREWER, *Sec'y.*

# REPORT OF THE TREASURER.

**Wm. H. Brewer**, *in account with the Connecticut Agricultural Experiment Station.*

## July 1st, 1886 to June 30th, 1887.

### RECEIPTS.

| | | |
|---|---|---|
| Balance from old account | $192.88 | |
| From Comptroller | 8,000.00 | |
| Analysis Fees | 3,759.48 | |
| Miscellaneous Receipts | 97.45 | |
| | | $12,049.81 |

### EXPENSES.

| | | |
|---|---|---|
| Salaries | $6,925.52 | |
| Laboratory expenses | 1,528.39 | |
| The Buildings, Grounds and Establishment, repairs, etc. | 1,023.06 | |
| Printing | 358.33 | |
| Stationery | 102.54 | |
| Postage | 219.43 | |
| Library | 188.79 | |
| Collecting Fertilizers | 468.97 | |
| Traveling expenses of the Board of Control | 29.12 | |
| Telephone | 100.15 | |
| Water | 132.00 | |
| Gas | 292.06 | |
| Fuel | 28.75 | |
| Herbarium | 198.30 | |
| Special Grass investigation | 202.70 | |
| Miscellaneous sundries | 248.31 | |
| Balance on hand | 3.39 | |
| | | $12,049.81 |

### MEMORANDUM.

There is due the Station ninety (90) dollars for laboratory work.

WILLIAM H. BREWER, *Treasurer.*

# REPORT OF THE DIRECTOR.

Under the requirements of the State Fertilizer Law, the greater part of the time and labor of the operating force of this Station has been expended, as usual, in work connected with the collection and analysis of Commercial Fertilizers.

The total number of brands legally sold in the state during the past year has been 128. The law requires this Station to make and publish annually at least one analysis of each of these, while examinations of home-mixed fertilizers and waste-products have brought the total number of fertilizer analyses up to 291. These analyses have been performed by Messrs. Farrington, Winton and Osborne. During April and a part of May the Station employed as special agents, Messrs. E. C. Ellwood of Green's Farms and C. L. Gold of West Cornwall, who visited more than one hundred towns in Connecticut, and drew in all nearly 600 samples of fertilizers, reporting also any cases where the requirements of the law appeared not to be fully met.

Twenty-two analyses of feeding stuffs have been made and the results of all accessible American analyses of this kind which have been published during the year have been tabulated by Dr. Jenkins and will be found in this Report.

Eight analyses of potatoes have been executed and incidental to this work a considerable amount of labor has been expended in comparing the different methods currently employed for determining starch. The results of this investigation by Mr. Winton appear in the following pages.

Six samples of Paris Green, now largely used on fruit trees as an insecticide, have been analyzed by Dr. Osborne for the purpose of determining their purity.

One sample of milk and one of the internal organs of a cow have been examined for suspected poisons, in both cases with negative results.

At the request of Hon. J. B. Tatem, Dairy Commissioner, the Station has made chemical examination of 34 samples of suspected butter, all but one of which proved to be imitation butter.

A law passed at the last session of the General Assembly provided for the inspection of molasses by the Dairy Commissioner. The Commissioner applied to the Station to make the necessary examinations of suspected samples. The Director was unprepared on his own responsibility to accede to the Commissioner's request, and for the following reasons :—

1. The first section of the Act creating the Station declares "That for the purpose of promoting agriculture by scientific investigation and experiments, an institution is hereby established, to be called and known as The Connecticut Agricultural Experiment Station." Since molasses is not made in this State and is not an agricultural but a manufacturing product it is evident that its analysis for the purpose of discovering adulteration is no more the proper duty of this Station than the study of the adulterations of any other article of general consumption.

2. The Station would require to make a considerable outlay for study of the methods and for the purchase of apparatus necessary for testing molasses, and to judge from its experience with oleomargarine would have to give much of the time of its chemists to this work.

The question was therefore referred to the Executive Committee, and it was decided that since the law would otherwise remain without effect, the Station should coöperate with the Dairy Commissioner as far as due regard to its other obligations would permit. Through the courtesy of Dr. Cook, Director, and Dr. Neale, Chemist, Dr. Jenkins was enabled to avail himself of the extensive experience in sugar analyses which these officers of the New Jersey Station have enjoyed, and spent some time at New Brunswick with their coöperation and assistance, in mastering the methods applicable to testing the purity of molasses. The Station has obtained from Germany the needful instruments for sugar-analysis, including a Polarimeter of the most improved construction (Halbschatten Polarisations-Apparat mit doppelter Keilcompensation, von Schmidt & Haensch). As yet but few examinations of molasses, have been completed for the Commissioner.

In continuation of his work, begun in 1886, Dr. Osborne has made further valuable contributions to the study of Methods of Mechanical Soil-Analysis and his results are included in this Report.

Mr. Farrington has made an elaborate comparison of Jodlbauer's modification of the Kjeldahl process of determining nitrogen, with the absolute method. His results are detailed in this Report.

Under arrangement with Mr. W. I. Bartholomew of Putnam a very instructive field experiment has been skilfully carried out to test the comparative value of certain phosphates on the corn crop, and in connection therewith a series of analyses have been made to determine the total quantities both of cattle food and mineral matters removed from an acre in the corn crop. Plans for performing a similar experiment which had been entered into were interrupted by the decease of Mr. Fairchild of Middletown.

In the latter pages of this Report will be found an account of the Forage Garden at this Station which was begun in September of 1886. The object in view in establishing this Garden and what has been accomplished thus far, are there set forth and need not be further noticed here. In carrying on that work the Station has been fortunate to be able to make avail of the very valuable and largely gratuitous services of Mr. J. B. Olcott, of South Manchester, who has labored for it and in it, with head and hands, in season and out of season. Mr. Farrington and Mr. Winton and especially Dr. Jenkins have contributed both mind and muscle to the care of this very troublesome but extremely interesting part of the Station grounds.

The Station has published and distributed in editions of 5000 copies, four printed bulletins, aggregating 49 pages. The object of these Bulletins is to place in the hands of those concerned the results of the Station work as promptly as possible.

As required by law, a package of each Bulletin is mailed to every post-office in the state. The package is directed to the postmaster, with a request to distribute to farmers. The number sent will be increased, in any case, on application. The distribution of these Bulletins is of course optional with the postmaster.

The Bulletins are also regularly sent to every Newspaper in the State, and to the Secretary of each Agricultural Society, Farmers' Club and Grange whose address is known to the Station.

The Bulletins are sent, also, on application, to any individual who wishes them. Such application, as a rule, must be renewed annually early in the year.

The Station has also issued fourteen Weekly Statements printed in a very limited edition by the hektograph process and supplied as far as possible to the agricultural press, and to Secretaries of farmers' clubs and agricultural societies.

The necessary Station correspondence increases from year to year and during the last twelve months has involved the sending of some 1500 manuscript letters and reports of analyses.

Besides receiving many calls from individual farmers the Station has been visited the last year by the Green's Farms Farmer's Club in a body and also by the Cheshire Grange, whose members to the number of seventy-five, came to the Station on an appointed day, bringing their lunch, and made a picnic on the Station grounds. It is hoped that other organizations of farmers will follow this example during the coming season. The Station officers will do all in their power to make visits interesting and profitable.

# THE CONNECTICUT FERTILIZER LAW.

The General Assembly at its session in 1882 passed a Fertilizer Law which went into effect September 1, 1882, and which repealed and took the place of all previous legislation on this subject. The law is still in force without any amendment. Since a full understanding of the provisions and penalties of this law is important to all who buy or sell commercial fertilizers the law is here reprinted and attention is specially directed to the following points:

1. In case of fertilizers that retail at ten dollars or more per ton, the law holds the SELLER responsible for *affixing a correct label or statement* to every package or lot sold or offered, as well as for the *payment of an analysis fee* of ten dollars for each fertilizing ingredient which the fertilizer contains or is claimed to contain, *unless* the MANUFACTURER OR IMPORTER shall have provided labels or statements and shall have paid the fee. Sections 1 and 3.

2. The law also requires, in case of any fertilizer selling at ten dollars or more per ton, that a *certified statement* of composition. net weight in package, etc., shall be filed with the Director of the Experiment Station, and that a *sealed sample* shall be deposited with him by the MANUFACTURER OR IMPORTER. Section 2.

3. It is also provided that EVERY PERSON in the State, who sells *any commercial fertilizer of whatever kind or price* shall annually report certain facts to the Director of the Experiment Station, and on demand of the latter shall deliver a sample for analysis. Section 4.

4. All "CHEMICALS" that are applied to land, such as : Muriate of Potash, Kainite, Sulphate of Potash and Magnesia, Sulphate of Lime (Gypsum or Land Plaster), Sulphate of Ammonia, Nitrate of Potash, Nitrate of Soda, etc.—are considered to come under the law as "Commercial Fertilizers." Dealers in these chemicals must see that packages are suitably labeled. They must also report them to the Station, and see that the analysis fees are duly paid, in order that the Director may be able to discharge his duty as prescribed in Section 9 of the Act.

Here follows the full text of the law, with explanatory footnotes.

## AN ACT CONCERNING COMMERCIAL FERTILIZERS.

General Assembly,
*January Session, A. D.* 1882.

***Be it enacted by the Senate and House of Representatives in General Assembly convened:***

*Printed statement* to be affixed to all packages and to go with all lots.

Section 1. Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure, the retail price of which is ten dollars, or more than ten dollars per ton, shall affix conspicuously to every package thereof a plainly printed statement, clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture and the chemical composition of the fertilizer, expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station.*

If any such fertilizer be sold in bulk, such printed statement shall accompany and go with every lot and parcel sold, offered, or exposed for sale.

Before sale *certified copies* of statement, and *Sealed Sample* to be deposited with Director.

Sec. 2. Before any commercial fertilizer, the retail price of which is ten dollars, or more than ten dollars per ton, is sold, offered, or exposed for sale, the manufacturer, importer, or party who causes it to be sold, or offered for sale, within the State of Connecticut, shall file with the Director of the Connecticut Agricultural Experiment Station two certified copies of the statement named in section one of this act, and shall deposit with said director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.*

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* A statement of the per cents. of Nitrogen, Phosphoric Acid ($P_2O_5$) and Potash ($K_2O$), and of their several states or forms, will suffice in most cases. Other ingredients may be named if desired.

In all cases the per cent. of *nitrogen* must be stated. Ammonia may also be given when actually present in ammonia salts, and "ammonia equivalent to nitrogen" may likewise be stated.

The per cent. of soluble and reverted phosphoric acid may be given separately or together, and the term "available" may be used in addition to, but not instead of soluble and reverted.

Insoluble phosphoric acid may be stated or omitted.

In case of Bone, Fish, Tankage, Dried Meat, Dried Blood, etc., the chemical composition may take account of the two ingredients: Nitrogen, Phosphoric Acid.

For Potash Salts give always the per cent. of Potash (potassium oxide); that of Sulphate of Potash or Muriate of Potash may also be stated.

The chemical composition of other fertilizers may be given as found in the Station Reports.

SEC. 3. The manufacturer, importer, agent, or seller of any commercial fertilizer, the retail price of which is ten dollars or more than ten dollars per ton, shall pay on or before the first of May, annually, to the Director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients† contained or claimed to exist in said fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any persons acting as agents or sellers for such manufacturer or importer, such agents or sellers shall not be required to pay the fee named in this section.

*Analysis Fee* to be paid annually on or before May 1st.

SEC. 4. Every person in this State who sells, or acts as local agent for the sale of any commercial fertilizer of whatever kind or price, shall annually, or at the time of becoming such seller or agent, report to the Director of the Connecticut Agricultural Experiment Station his name, residence, and post-office address, and the name and brand of said fertilizer, with the name and address of the manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the Director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.‡

*Yearly Report* to Station of Dealers or Agents.

SEC. 5. No person or party shall sell, offer, or expose for sale, in the State of Connecticut, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure, and to accompany and go with every parcel or lot of the same.

Leather.

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* The analysis of samples sent in accordance with section two is discretionary with the Station. Such samples are intended for preservation as manufacturers' standards.

† The Station understands "the fertilizing ingredients" to be those whose determination in an analysis is necessary for a valuation, viz: Nitrogen, Phosphoric acid and Potash. The analysis-fees in case of any fertilizer will therefore be ten, twenty or thirty dollars, according as one, two or three of these ingredients are contained or claimed to exist in the fertilizer.

On receipt of statements, samples and analysis-fees, the Station will issue Certificates of Compliance with the law.

‡ Blanks for Dealers' Reports will be mailed to applicants.

Fish-guano, &c.

SEC. 6. Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish-mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemical, approved by the director of said experiment station, in such quantity as to arrest decomposition: *provided, however*, that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

Fines.

SEC. 7. Any person violating any provision of the foregoing sections of this act shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation.

Fertilizers for private use.

SEC. 8. This act shall not affect parties manufacturing, importing, or purchasing fertilizers for their own private use, and not to sell in this State.

Director's duties and authority.

SEC. 9. The director of the Connecticut Agricultural Experiment Station shall pay the analysis-fees received by him into the treasury of the station, and shall cause one or more analysis of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer.

Bulletins.

SEC. 10. The director of the Connecticut Agricultural Station shall, from time to time, as bulletins of said station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State.

Repeal of former acts.

SEC. 11. Title sixteen, chapter fifteen, sections fifteen and sixteen, and title twenty, chapter twelve, section five of the general statutes, and chapter one hundred and twenty of the public acts of 1881, being an act concerning commercial fertilizers, are hereby repealed.

SEC. 12. This act shall take effect on the first day of September, 1882.

It will be noticed that the State exacts no license tax either for making or dealing in fertilizers. For the safety of consumers and the benefit of honest manufacturers and dealers, the State requires that it be known what is offered for sale, and whether fertilizers are what they purport to be. With this object in view the law provides, in section 9, that all fertilizers be analyzed and it requires the parties making or selling them to pay for these analyses in part; the State itself paying in part by maintaining the Experiment Station.

## OBSERVANCE OF THE FERTILIZER LAW.

**MANUFACTURERS who have paid Analysis Fees as required by the Fertilizer Law, and Fertilizers for which the Fees have been paid for the year ending May, 1888.**

| *Firm.* | *Brand of Fertilizer.* |
|---|---|
| Adams, Wm. P., 248 Front St., N. Y. | Adams' Ammoniated Bone Superphosphate. |
| Adams & Thomas, Springfield, Mass. | Adams' Market Bone Fertilizer. |
| American Oil Co., 18 Broadway, N. Y. | Cotton Hull Ashes. |
| Apothecaries Hall Co., Waterbury, Conn. | Victor Phosphate. |
| H. J. Baker & Bro., 215 Pearl St., N. Y. | A. A. Ammoniated Superphosphate. |
| | Pelican Bone Fertilizer. |
| | Potato Fertilizer. |
| | Corn Fertilizer. |
| | Strictly Pure Ground Bone. |
| | Castor Pomace. |
| | Ground Bone. |
| Bennett, P. W., Rockfall, Conn. | Stockbridge Grain Manure. |
| | " Forage Crop Manure. |
| | " Vegetable Manure. |
| Bowker Fertilizer Co., 43 Chatham St., Boston, Mass. | Bowker's Hill and Drill Phosphate. |
| | " Fish and Potash. |
| | " Ammoniated Dissolved Bone. |
| | " Dry Fish. |
| Bradley Fertilizer Co., 27 Kilby Street, Boston, Mass. | Bradley's Complete Manure for Potatoes and Vegetables. |
| | Bradley's Complete Manure for Corn and Grain. |
| | Bradley's Complete Manure for Top Dressing Grass and Grain. |
| | Bradley's Superphosphate. |
| | B. D. Sea Fowl Guano. |
| | Original Coe's Superphosphate. |
| | Circle Brand Ground Bone and Potash. |
| | Bradley's Potato Manure. |
| | Farmer's New Method Fertilizer. |
| | Pure Fine Ground Bone. |
| | Fish and Potash, Anchor Brand. |
| | " " " Triangle A Brand. |
| Clark's Cove Guano Co., New Bedford, Mass. | Bay State Fertilizer. |
| | Unicorn Ammoniated Superphosphate. |
| | King Phillip Alkaline Guano. |
| | Great Planet A Fertilizer. |
| | " " B " |
| Coe, E. Frank, 16 Burling Slip, N. Y. | High Grade Ammoniated Bone Superphosphate. |
| | Alkaline Bone. |
| | Red Brand Excelsior Guano. |
| | Ground Bone. |
| | Fish and Potash. |
| Coe, Russell, Tremley, N. J. | Ammoniated Bone Superphosphate. |
| Collier White Lead & Oil Co., St. Louis, Mo., by F. Ellsworth, Hartford, Conn. | Collier Castor Pomace. |
| Common Sense Fertilizer Co., 42 Congress St., Boston, Mass. | Common Sense Fertilizer, No. 2. |
| | " " " No. 22. |

| *Firm.* | *Brand of Fertilizer.* |
|---|---|
| Cooper's, Peter, Glue Factory, 17 Burling Slip, New York. | Peter Cooper's Bone Dust. |
| Crocker's Fertilizer & Chemical Works, Buffalo, N. Y. | Ammoniated Bone Superphosphate. |
| | Potato, Hop and Tobacco Phosphate. |
| | Queen City Phosphate. |
| | Pure Ground Bone. |
| Cumberland Bone Co., Portland, Me. | Cumberland Superphosphate. |
| Dambmann Bros. & Co., 13 German St., Baltimore, Md. | The Improved Blood Guano. |
| Darling, L. B., Fertilizer Co., Pawtucket, R. I. | Darling's Animal Fertilizer. |
| | " Extra Phosphate. |
| | " Pure Fine Bone. |
| Dickenson, D. B., Middle Haddam, Conn. | Ammoniated Bone Phosphate. |
| Kelsey, E. R., Branford, Conn. | Fish and Potash. |
| Lister Agricultural Chemical Works, Newark, N. J. | Potato Fertilizer. |
| | Standard Phosphate. |
| | Ammoniated Dissolved Bone. |
| | Ground Bone. |
| Mapes' Formula & Peruvian Guano Co., 158 Front St., New York. | Mapes' Potato Manure. |
| | " Corn " |
| | " Complete Manure for light soil. |
| | " " " A Brand. |
| | " " " for general use. |
| | " Fine Bone Dissolved. |
| | " Ground Bone. |
| | " Tobacco Manure, Conn. Brand. |
| | " " " for use with stems. |
| | " Grass and Grain Spring Top Dressing. |
| | Mapes' Peruvian Guano. |
| Meyer, C., Jr., Maspeth, L. I. | Acme Fertilizer, No. 1. |
| | " " No. 2. |
| Miles, G. W., Agent, Milford, Conn. | Fish and Potash, Fish Brand. |
| | I. X. L. Ammoniated Bone Superphosphate. |
| Miller, G. W., Middlefield, Conn. | Flour of Bone Phosphate. |
| | Pure Ground Bone. |
| Mitchell, A., Tremley, N. J. | Standard Phosphate. |
| National Fertilizer Co., Bridgeport, Conn. | Chittenden's Complete Fertilizer. |
| | " Ammoniated Bone Phosph. |
| | " Fish and Potash. |
| | " Ground Bone. |
| Newton & Ludlam, 182 Front St., N. Y. | Cereal Fertilizer. |
| | Cecrops or Dragon's Tooth Fertilizer. |
| Orient Guano Manufacturing Co., Orient, L. I. | Orient Complete Manure. |
| | Fish and Potash. |
| Peck Bros., Northfield, Conn. | Pure Ground Bone. |
| Prentice, Charles, Putnam, Conn. | Potato Phosphate. |
| | Phosphate. |
| | Ground Bone. |
| Preston Fertilizer Co., Green Point, L. I. | Ammoniated Bone Superphosphate. |
| | Ground Bone. |
| Quinnipiac Co., New London, Conn. | Quinnipiac Phosphate. |
| | Pine Island Ammoniated Phosphate. |
| | Fish and Potash, Crossed Fishes Brand. |
| | " " " Plain Brand. |
| | Dry Ground Fish. |
| | Bone Meal. |
| | Potato Manure. |
| | Muriate of Potash. |

| *Firm.* | *Brand of Fertilizers.* |
|---|---|
| Rogers & Hubbard Co., Middletown, Ct. | Raw Knuckle Bone Flour.<br>Ground Bone, Grade AX.<br>Fairchild's Formula, Bone and Potash.<br>Fairchild's Formula for Corn and Wheat. |
| Ruth, R. J. & Co., 88 Wall St., N. Y. | Good Luck Guano. |
| Sanderson, L., 113 Long Wharf, New Haven, Conn. | Sulphate of Ammonia.<br>Dried Blood.<br>Dissolved Bone Black.<br>Ground Bone.<br>Kainit.<br>Muriate of Potash.<br>Sulphate of Potash.<br>Nitrate of Soda.<br>Tankage. |
| Shoemaker, M. L. & Co., Philadelphia, by F. Ellsworth, Hartford, Conn. | Swift Sure Superphosphate.<br>" " Bone Meal. |
| Soluble Pacific Guano Co., Gildden & Curtis, agents, Boston, Mass. | Soluble Pacific Guano.<br>Fish and Potash. |
| Standard Fertilizer Co., 30 Kilby Street, Boston, Mass. | Standard Superphosphate. |
| St. Louis Lead & Oil Co., St. Louis, Mo., by Olds & Whipple, Hartford, Conn. | St. Louis Lead & Oil Co.'s Castor Pomace. |
| Wilkinson & Co., 239 Center St., N. Y. | Wilkinson's Economical Bone Fertilizer.<br>" Ammoniated Superphosphate. |
| Williams & Clark Co., Hanover Square, New York. | Americus Bone Superphosphate.<br>" Potato Fertilizer.<br>" Bone Meal.<br>" Tobacco and Onion Fertilizer.<br>Royal Bone Phosphate.<br>Fish and Potash. |

## ANALYSES OF FERTILIZERS.*

In respect to its terms, the Station makes *two classes* of analyses of fertilizers and fertilizing materials: the first for the benefit of farmers, gardeners, and the public generally; the second for the private use of manufacturers and dealers. Analyses of the *first class* are made gratuitously, and the results are published as speedily and widely as possible for the guidance of purchasers and consumers. Those of the *second class* are charged for at moderate rates, and their results are not published in a way to interfere with their legitimate private use. The Station, however, distinctly reserves the liberty to use at discretion, for the public benefit, all results obtained in its laboratory, and in no case will enter into any privacy that will work against the public good.

* The matter of this and several subsequent pages, explanatory of the sampling and valuation of fertilizers, is copied, with a few appropriate alterations, from the Report for 1886. This repetition appears to be necessary for the use of readers who have not seen former Reports.

During 1887, two hundred and ninety (290) samples of fertilizers have been analyzed. Of these, a small number were examined for private parties and for testing methods in connection with other Experiment Stations, and the remainder for the general use of the citizens of the State.

During April and a part of May last, Messrs. E. C. Ellwood, of Green's Farms, and C. L. Gold, of West Cornwall, were employed as agents of the Station to collect fertilizer samples for analysis.

These gentlemen discharged their duties most satisfactorily as the following statement will show. One hundred and one towns or villages were visited:

| | |
|---|---|
| In Litchfield County | 16 |
| Hartford " | 15 |
| Tolland " | 9 |
| Windham " | 3 |
| New London " | 21 |
| Middlesex " | 2 |
| New Haven " | 10 |
| Fairfield " | 25 |
| | 101 |

About 560 samples of commercial fertilizers were drawn from lots which amounted in the aggregate to over 2700 tons. One or more samples were obtained of nearly every brand of goods sold in Connecticut.

When several samples of a single brand were collected the analysis was in most cases made on a mixture of equal quantities of each sample. A single analysis of such a mixture represents more nearly the average composition of a given brand than an analysis made on one sample or on a number of samples from one locality.

Besides the samples drawn by these special agents a considerable number have been taken by the Station chemists, 19 samples have been analyzed which were drawn by private persons and of these 13 were commercial fertilizers whose sale is regulated by the fertilizer law.

The Station agents are instructed when drawing samples to open at least three packages of each brand of goods in every case, and if the number of packages is large, to take a portion from every tenth one, by means of a sampling tube, which withdraws a section or core through the entire length of the package.

The greatest care is necessary in sampling fertilizers that the small sample taken shall accurately represent the whole stock from which it is drawn. Otherwise serious injustice may be done.

The Station desires the coöperation of farmers, farmers' clubs and granges in calling attention to new brands of fertilizers and in securing samples of all goods offered for sale. All samples drawn by other than Station agents are understood to be taken in accordance with the printed instructions which the Station supplies to all applicants. Here follows a copy of these instructions.

### GRATUITOUS ANALYSIS OF COMMERCIAL FERTILIZERS.

To insure justice to manufacturers, dealers and consumers alike, the Station will make gratuitous analyses of Commercial Fertilizers only on samples taken by the Agents of the Station or on such other samples as are fully described on the Station Forms for Description and taken in accordance with the Station Instructions for sampling and furthermore are properly authenticated by the certificate of the person drawing the sample *and in addition* the witness, either

1. Of a Selectman;
2. Of an Officer of a farmer's club, grange or local agricultural society; or
3. Of the Dealer from whose stock the sample is taken.

In case a Dealer takes samples of his own stock, the witness of one of the Officers aforesaid will be required.

In special cases of importance the Station may send its Agent to draw samples.

### INSTRUCTIONS FOR SAMPLING COMMERCIAL FERTILIZERS.

1. Provide a teacup, some large papers and for each sample a glass fruit can or tin box holding about one quart that can be tightly closed, all to be clean and dry.

2. Open at least three full and unbroken packages, or if there are more than thirty, every tenth package, and mix well together the contents of each for a foot in depth, take out two cupfuls from different parts of the mixed portions of each package, pour them [six in all] one over another upon a paper, intermix thoroughly but quickly to avoid gain or loss of moisture, fill the can or box from this mixture, close tightly, fix securely on the outside of the can a label with some distinguishing letter or mark (which is to be copied in the "Description of Sample" as *sampler's mark*), and

send prepaid to the Agricultural Experiment Station, New Haven, Conn.

3. If convenient weigh separately at least three packages and enter these *actual weights* in the "Description of Sample."

4. When a sample has been taken it should *always* be bottled, labeled and the form for its description filled out completely *before* beginning to sample another fertilizer.

### FURTHER REMARKS ON SAMPLING.

In case of a fine, uniform and moist or coherent article, a butter-tryer or a tin tube, like a dipper handle, put well down into the packages in several places, will give a fair sample with great ease.

With dry, coarse articles, such as ground bone, there is liable to be a separation of coarse and fine parts on handling. Moist articles put up in bags or common barrels may become dry on the outside. It is in these cases absolutely necessary to mix thoroughly the coarse and fine, the dry and the moist portions befor sampling.

The quantity sent should not be too small. When the material is fine and uniform, a pint is enough, but otherwise and especially in the case of ground bone, which must be mechanically analyzed, the sample should not be *less than one quart.*

It is important that samples for analysis should be taken at the time when the fertilizer is purchased, and *immediately dispatched* to the Station. Moist fish, blood or cotton seed meal will soon decompose and lose ammonia, if bottled and kept in a warm place. Superphosphates containing much organic nitrogen will suffer reversion of their soluble phosphoric acid under similar circumstances. Most of the moist fertilizers will lose water unless tightly bottled, but some of the grades of potash salts will gather moisture from the air and become a slumpy mass if not thoroughly protected.

Samples as to whose authenticity or fairly representative character there is any reasonable doubt, the Station will not analyze. The Station reserves the right to reject samples taken from less than half a ton of stock or those drawn from goods that have been wintered over from last year.

Send with each sample any printed circular, pamphlet, analysis or statement that accompanies the fertilizer or is used in its sale.

## DESCRIPTION OF SAMPLE.

Station No........ Rec'd at Station,................., 188

Each sample of Commercial Fertilizer sent for gratuitous analysis *must* be accompanied by a Description made by filling out legibly and as fully as possible, the blanks that follow:

Sampler's Mark,..............................................
Brand of Fertilizer,...........................................
Name and address of Manufacturer,........................
.......................................................................
Name and address of Dealer from whom this sample was taken,
.......................................................................
Date of taking this sample,.................................
Is it stated to be fresh stock?.............................
Dealer's cash price per ton or hundred, bag or barrel,...........
Selling weight claimed for each package weighed,..............
Actual weight of the several packages opened................
Number of packages from which the sample was taken,..........

Here write the per cents of valuable ingredients which the fertilizer is guaranteed to contain.

Soluble Phosphoric Acid,.................Nitrogen,..........
Reverted Phosphoric Acid, ...............(Ammonia,.........)
(Available Phosphoric Acid,...............) Potash, ..........
Insoluble Phosphoric Acid,.................................

## CERTIFICATE OF PERSON TAKING THE SAMPLE.

I, the undersigned, certify that the accompanying sample marked......was taken by me from full packages, and in accordance with the Station's Instructions for Sampling and to the best of my knowledge and belief fairly represents the stock from which it was drawn, and that said stock when sampled was properly housed and in good condition. I also certify that the foregoing description is correct.

Signature ...........................................
Post Office address..................................

## WITNESS OF OFFICER OR DEALER.

The above described sample was drawn in my presence.

Signature ...........................................
Title ...........................................
Township ...........................................
Post Office Address..................................

On receipt of any sample of fertilizer from the open market, the filled out "Form for Description" which accompanies it is filed in the Station's Record of Analyses, and remains there as a voucher for the authenticity of the sample and for the fact that it has been taken fairly, or, at least, under suitable instructions. It is thus sought to insure that manufacturers and dealers shall not suffer from the publication of analyses made on material that does not correctly represent what they have put upon the market.

The "Form for Description," when properly filled out, also, contains all the data of cost, weight, etc., of a fertilizer which are necessary for making, with help of the analysis, a valuation of its fertilizing elements, and estimating the fairness of its selling price. Neglect to give full particulars occasions the Station much trouble, and it is evident that want of accuracy in writing up the description may work injustice to the manufacturers or dealers, as well as mislead consumers. It is especially important that the *brand* of a fertilizer and its *selling price* shall be correctly given. The price should be that actually charged by the dealer of whom it is bought, and if the article be purchased in New York or other distant market, that fact should be stated, and the cost at the nearest point to the consumer, on rail or boat, should be reported also.

In all cases, when possible, *ton prices* should be given, and if the sale of an article is only by smaller quantities, that fact should be distinctly mentioned.

Samples are analyzed as promptly as possible in the order in which they are received. As soon as an analysis is completed a copy of it is sent to the party who furnished the sample and also to the manufacturer, in order that there may be opportunity for explanation or protest, if desirable, before the results are published in the Bulletin.

With the analysis there is sent to the party furnishing the sample a printed page of "Explanations," intended to embody the principles and data upon which the valuation of fertilizers is based.

These Explanations are essential to a correct understanding of the analyses that are given on subsequent pages, and are, therefore, reproduced here, as follows:

## EXPLANATIONS CONCERNING THE ANALYSIS OF FERTILIZERS AND THE VALUATION OF THEIR ACTIVE INGREDIENTS.

### REVISED.

*Nitrogen* is commercially the most valuable fertilizing element. *Organic nitrogen* is the nitrogen of animal and vegetable matters. Some forms of organic nitrogen, as those of blood and meat, are highly active as fertilizers; others, as found in leather and peat, are comparatively slow in their effect on vegetation, unless these matters are chemically disintegrated. *Ammonia* and *nitric acid* are results of the decay of *organic nitrogen* in the soil and manure heap, and are the most active forms of Nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda. 17 parts of ammonia or 66 parts of pure sulphate of ammonia contain 14 parts of nitrogen. 85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

*Soluble Phosphoric acid* implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of Superphosphates, in which it is produced, by acting on "insoluble" or "reverted" phosphates, with oil of vitriol. Once well incorporated with the soil it gradually becomes reverted phosphoric acid.

*Reverted* (*reduced or precipitated*) *Phosphoric acid* means strictly, phosphoric acid that was once easily soluble in water, but from chemical change has become insoluble in that liquid. In present usage the term signifies the phosphoric acid (of various phosphates) that is freely taken up by strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops.

Recent investigation tends to show that soluble and reverted phosphoric acid are on the whole about equally valuable as plant-food and of nearly equal commercial value. In some cases, indeed, the soluble gives better results on crops, in others the reverted is superior. In most instances there is probably little to choose between them.

*Insoluble Phosphoric acid* implies various phosphates not soluble in water or ammonium citrate. In some cases the phosphoric acid is too insoluble to be readily available as plant food. This is especially true of Canada Apatite. Bone black, bone-ash, South Carolina Rock and Navassa Phosphate when in coarse powder are commonly of little repute as fertilizers though good results are occasionally reported from their use. When *very finely pulverized* ("floats") they more often act well, especially in connection with abundance of decaying vegetable matters. The phosphate of raw bones is nearly insoluble, because of the animal matter of the bones, which envelopes it; but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

*Potash* signifies the substance known in chemistry as potassium oxide, which is the valuable fertilizing ingredient of "potashes" and "potash salts." It should be soluble in water and is most costly in the form of sulphate, and cheapest in the shape of muriate (potassium chloride).

*The Valuation of a Fertilizer*, as practised at this Station, signifies finding *the worth in money or trade-value, of its fertilizing ingredients.* This value, it should be remembered, is *not necessarily proportional to its fertilizing effects* in any special case.

Plaster, lime, stable manure and nearly all of the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and similar articles, for which $30 to $60 per ton are paid, depend chiefly for their trade-value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money-value per pound of these ingredients is reckoned from the current market prices of the standard articles which furnish them to commerce.

The consumer, in estimating the reasonable price to pay for high-grade fertilizers, should add to the *Trade Value of the above-named Ingredients*, a suitable margin for the expenses of manufacture, etc., and for the convenience or other advantage incidental to their use.

*The average Trade-values* or retail cost in market, per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as found in the New England, New York and New Jersey markets, are as follows :—

These Trade-values were agreed upon by the Experiment Stations of Connecticut, New Jersey and Massachusetts for use in their several States during 1887.

## TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS FOR 1887.

| | Cents per lb. |
|---|---|
| Nitrogen in ammonia salts | 17½ |
| " " nitrates | 16 |
| Organic nitrogen in dried and fine ground fish | 17½ |
| " " azotin, ammonite and dry ground meat | 17½ |
| " " castor pomace | 17½ |
| " " dried and fine ground blood | 16½ |
| " " fine ground bone and tankage | 16 |
| " " fine-medium bone and tankage | 14 |
| " " medium bone and tankage | 12 |
| " " coarse-medium bone and tankage | 10 |
| " " coarse bone and tankage, horn shavings, hair and fish scrap | 8 |
| Phosphoric acid, soluble in water | 8 |
| " " soluble in ammonium citrate * | 7½ |
| " " in dry ground fish | 7 |
| " " in fine bone and tankage | 7 |
| " " in fine-medium bone and tankage | 6 |
| " " in medium bone and tankage | 5 |
| " " in coarse medium bone and tankage | 4 |
| " " in coarse bone and tankage | 3 |
| " " in fine ground rock phosphate | 2 |
| Potash as high grade sulphate and in forms free from muriate (or chlorides) | 5½ |
| " as kainit | 4½ |
| " as muriate | 4½ |

The above trade-values are the figures at which on March 1st, the respective ingredients could be bought at retail for cash, in our markets, in the *raw materials* which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1st, plus about 20 per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to

* Dissolved from 2 grams of the unground phosphate previously extracted with pure water, by 100 c.c. neutral solution of Ammonium Citrate, sp. gr. 1.09, in 30 minutes, at 65° C., with agitation once in five minutes. Commonly called "reverted" or "backgone" Phosphoric Acid.

agree fairly with the *reasonable retail price* in case of standard raw materials such as:—

Sulphate of Ammonia,
Nitrate of Soda,
Muriate of Potash,
Sulphate of Potash,
Dried Blood,
Plain Superphosphate.
Azotin,
Dry Ground Fish,
Cotton Seed,
Castor Pomace,
Bone,
Ground So. Car. Rock.

## Trade Values in Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

The Organic Nitrogen in these classes of goods is reckoned at the highest figure laid down in the Trade-Values of Fertilizing Ingredients in Raw Materials, namely 17½ cents per pound, it being assumed that the organic nitrogen is derived from the best sources, viz: bone, tankage, blood, fish, castor pomace or other equally good forms and not from leather, shoddy, hair or any low-priced inferior forms of vegetable matter, unless the contrary is ascertained.

Insoluble Phosphoric Acid is reckoned at 3 cents, it being assumed, unless found otherwise, that it is from bone or similar source and not from rock phosphate. In this latter form the insoluble phosphoric acid is worth but 2 cents per pound. Potash is rated at 4½ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash is reckoned as sulphate at 5½ cents.

In most cases the valuation of the Ingredients in Superphosphates and Specials falls below the retail price of these goods. The difference between the two figures, represents the manufacturer's charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and finally, profits. The majority of manufacturers agree that the average cost of mixing, bagging, handling and cartage ranges from $3.00 to $4.50 per ton.

In 1887 the average selling price of Ammoniated Superphosphates and Guanos was $35.74, the average valuation was $28.45 and the difference $7.29, an advance of 25.6 per cent. on the valuation and on the wholesale cost of the fertilizing elements in the raw materials.

In case of Specials the average cost was $42.52, the average valuation $35.20, and the difference $7.32 or about 20.9 per cent. advance on the valuation.

*To obtain the Valuation of a Fertilizer* (i. e. the money-worth of its fertilizing ingredients), we multiply the pounds per ton of Nitrogen, etc., by the trade-value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

In case of *Ground Bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen-value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the trade-value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the Valuation of the sample of bone.

*The uses of the "Valuation"* are twofold:

1, To show whether a given lot or brand of fertilizer is worth, as a commodity of trade, what it costs. If the selling price is not higher than the valuation, the purchaser may be quite sure that the price is reasonable. If the selling price is several dollars per ton more than the valuation, it may still be a fair price; but in proportion as the cost per ton exceeds the valuation there is reason to doubt the economy of its purchase.

2, Comparisons of the valuations and selling prices of a number of similar fertilizers will generally indicate fairly which is the best for the money.

But the valuation is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes of the trade-values are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth, when their valuations are deduced from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of a year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor.

*The Agricultural value* of a fertilizer is measured by the benefit received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that Peruvian guano, superphosphates, fish-scraps, dried blood, potash salts, plaster, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place, and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

## CLASSIFICATION OF FERTILIZERS ANALYZED.

The fertilizers and manurial waste products analyzed at the Station laboratory from November 1st, 1886, to Nov. 1st, 1887, were as follows :

| | |
|---|---|
| Phosphate rock | 2 |
| Thomas-Slag | 1 |
| Superphosphates (plain) | 14 |
| Superphosphates (nitrogenous) and guanos | 16 |
| Home-mixed Superphosphates and other fertilizers | 11 |
| Special Manures | 28 |
| Bone Manures | 26 |
| Bone and Potash | 2 |
| Tankage and Animal Dust | 16 |
| Dried Blood | 6 |
| Tallow Scrap | 1 |
| Castor Pomace | 3 |
| Nitrate of Soda | 4 |
| Sulphate of Ammonia | 3 |
| Sulphate of Potash | 7 |
| Muriate of Potash | 13 |
| Kainit | 6 |
| Cotton Hull Ashes | 10 |
| Plaster | 1 |
| Wood Ashes | 6 |
| Waste Lye from Soap Works | 1 |

| | |
|---|---|
| Lime Kiln Ashes | 1 |
| Corn Cob Ashes | 1 |
| Coal Ashes | 1 |
| Tobacco Stalks | 1 |
| "Muck" | 2 |
| Salt Marsh Mud and Soil | 8 |
| | 291 |

A number of these samples were analyzed in connection with other Experiment Stations for the purpose of testing methods and comparing results, and for private persons. The remaining analyses are given in detail so far as they have any general interest, with such discussion as may make them more serviceable. In all cases the samples were drawn by agents of the Station unless the contrary is stated.

### THOMAS-SLAG.

**2150.** This by-product of the mamufacture of steel from ores containing phosphorus is a fine powder which easily passes a $\frac{1}{50}$ inch sieve. A sample drawn from stock of J. H. Ives, Danbury, bought by him for experiment, had the following composition :

| | |
|---|---|
| Phosphoric acid soluble in water | none |
| " " soluble in ammonium citrate | 6.29 |
| " " insoluble in ammonium citrate | 13.19 |
| Total phosphoric acid | 19.48 |

This more nearly represents the average composition of the goods than the analysis of another sample given in last year's report. For results of the use of Thomas-Slag as a fertilizer on Indian corn see page 122.

### PLAIN SUPERPHOSPHATES.

These are superphosphates which do not contain notable quantities either of potash or nitrogen. They are prepared from phosphatic materials of various kinds by treatment with oil of vitriol, [sulphuric acid], which renders a large proportion of the phosphoric acid soluble in water. Most superphosphates sold in this State are made from bone, bone black, South Carolina phosphate rock or Navassa phosphate. They are usually sold with a guarantee of the percentage of "available" phosphoric acid. This is a trade name for the phosphoric acid which is soluble either in water or in a neutral solution of ammonium citrate. See foot note, page 27.

**1942.** Dissolved Bone Black. Made by C. Meyer, Jr., Maspeth, L. I. Stock of G. F. Platt, Milford.

**1893.** Dissolved Bone Black. Stock of L. Sanderson, New Haven.

**2005.** Dissolved Bone Black. Made by C. M. Beach, West Hartford, and used in home mixtures.

**1941.** Pure Dissolved Bone. Sold by H. J. Baker & Bro., N. Y. Stock of Dennis Fenn, Milford.

**2143.** "Dissolved Bones." Made by H. Preston & Son, Greenpoint, Long Island. Stock of J. B. Merrow & Son, Merrow Station.

**2142.** "Plain Dissolved Bone." Made by Williams, Clark & Co., New York. Stock of A. P. Smith & Son, Lebanon.

**2006.** Dissolved South Carolina Rock. Bought of G. H. Nichols & Co., N. Y., by C. M. Beach, West Hartford, and used in home mixtures.

ANALYSES.

| | 1942 | 1893 | 2005 | 1941 | 2143* | 2142 | 2006 |
|---|---|---|---|---|---|---|---|
| Soluble Phosphoric Acid | 13.62 | 15.55 | 9.05 | 17.35 | 4.36 | 10.88 | 13.15 |
| Reverted Phosphoric Acid | 2.55 | .10 | 4.99 | .17 | 10.21 | 2.28 | .36 |
| Insoluble Phosphoric Acid | .25 | .18 | 3.74 | .11 | 6.25 | 1.14 | 1.89 |
| Cost per ton | $31.00† | 26.00 | 24.00 | 26.00 | 32.00 | 25.00 | 16.40‡ |

No. **2005** was made by the following formula:

1000 lbs. bone black.
400 " oil of vitriol, 66° B.
400 " water.

The bone black cost $22.00 per ton in New York, the oil of vitriol cost $1.25 per 100 lbs., and the total cost per ton of the superphosphate is reckoned at $24.00. Only in exceptional cases will it pay to buy bone black and dissolve it on the farm. The experiment in this case seems to have been successful. A larger proportion of acid would have more completely decomposed the bone black.

In general the cost of soluble phosphoric acid in bone black superphosphate has been somewhat higher than that adopted by the Station for the valuation of mixed fertilizers:—thus the actual costs of soluble, reverted and insoluble phosphoric acid in the three samples of bone black superphosphate, Nos. **1942**, **1893** and **1941** were, for soluble phosphoric acid, 8.5 cents per pound, for reverted phosphoric acid, 8 cents and for insoluble phosphoric acid, 2.1 cents; but the Station valuation for phosphoric acid is high when applied to superphosphates made from South Carolina rock which is the base most commonly used. The actual costs in No. **2006** were: for soluble phosphoric acid, 5.9 cents per pound, for reverted, 5.5 cents, and for insoluble, 1.5 cents.

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* This sample also contained .67 per cent of nitrogen.

† In Milford.

‡ At the Farm.

### NITROGENOUS SUPERPHOSPHATES AND GUANOS.

Here are included all mixed fertilizers containing nitrogen, phosphoric acid, and in most cases, potash, which are not designed by their manufacturers for use on any special crops. "Special Manures" are noticed further on. Fish scrap is classified with these goods because it is sometimes acidulated with oil of vitriol to preserve it, thus making it a nitrogenous superphosphate.

### I. SAMPLES DRAWN BY STATION AGENTS.

In the tables on pages 38–49 are given sixty-six analyses of this kind. After the name of a brand of goods the names of a number of dealers are frequently given. This indicates that a sample of the goods was drawn by our agent from each dealer named and that the corresponding analysis was made on a mixture of equal parts of each of these samples.

The Station assumes full responsibility for accuracy of sampling and analysis only on such samples as are drawn by its own agents. On samples drawn by other persons the Station holds itself responsible only for the accuracy of analysis, but requires before making an analysis a formal statement that the person who drew the sample did it in accordance with the Station directions. See page 21.

Early in the year a circular was sent to all manufacturers whose goods were sold in Connecticut, asking them to inform the Station what would be about the average cash price of their goods in this State during the coming season. Replies were received from most of them. In the tables with the various *dealers'* quotations is also given for comparison the *manufacturers'* statement of the average retail cash price per ton in the State. The cash prices are usually about five per cent. lower than the credit or "time" prices.

The retail cash price of the same fertilizer as quoted by different dealers varies in some cases considerably, partly on account of differences in freight-rates, presence or absence of competition, etc.

The last column of the table of analysis is "Percentage Difference between Cost and Valuation." Its significance and the method of calculating it may be seen by noticing the fourth analysis in the table on page 46, No. **2046.** Here the cost is $28, the valuation is $26.65, and the difference between them is $1.35. By multiplying this difference, $1.35, by 100, and dividing it by the valuation, $26.65, we get the percentage advance of selling price over valuation, which advance should represent the costs and profits of the manufacturer in converting the raw materials into a mixed fertilizer, selling it and collecting on his sales.

Certain brands of superphosphates on which analysis fees have been paid as required by law are not included in the tables for they were not found by our agents in any of the places visited by them.

In case the manufacturers of these brands sent samples, this year, in compliance with the law, such samples have been analyzed and tabulated on page 51 as "Manufacturers' Samples."

### 1. *Special Notice of Certain Analyses.*

**2119.** Victor Phosphate. This brand is made for the Apothecaries Hall Co. by a fertilizer company outside of this State. In May last a Station Agent drew a sample from six bags of this brand in stock of Apothecaries Hall Co., Waterbury. Its analysis is given below, No. **2017.** The analysis was a disappointment to the Apothecaries Hall Co., who protested to the manufacturer. The manufacturer insisted that the analysis was wrong because he knew what was in the goods! At the request of the Apothecaries Hall Co., another agent was sent June 7 who drew from 18 packages the sample numbered **2069** whose analysis is given below.

The manufacturer still objected and the Station then proposed to send an agent to meet an agent of the manufacturer and that they together should sample the goods and divide the sample. This was done August 10th and a sample was taken from every tenth bag in the stock; these samples were mixed and the lot divided. The analysis is No. **2113.**

These three analyses which illustrate the degree of accuracy obtainable in sampling have been averaged and the average is given in the table No. **2119,** page 47. Because of the lower grade of the goods the Apothecaries Hall Co. have reduced the price below what it was in 1886.

| | 2017 | 2069 | 2113 |
|---|---|---|---|
| Nitrogen | 1.04 | 1.02 | 1.15 |
| Soluble Phosphoric Acid | 6.94 | 7.25 | 6.93 |
| Reverted Phosphoric Acid | 1.90 | 1.47 | 1.79 |
| Insoluble Phosphoric Acid | 1.14 | 1.33 | 1.17 |
| Total Phosphoric Acid | 9.98 | 10.05 | 9.89 |
| Potash | 2.41 | 2.58 | 2.09 |
| Chlorine | 2.64 | 2.52 | 2.39 |
| Valuation per ton | $20.32 | 20.37 | 20.51 |

The tables contain two analyses each, of G. W. Miles' Fish and Potash, **2042** and **2095**, and of his IXL superphosphate **2039** and **2088**.

The earlier analysis of each was objected to by the manufacturer as misrepresenting the goods and the stock subsequently analyzed was stated to be of representative quality. There is, however, but little difference in quality in either case between the two samples.

There are also two analyses of Russell Coe's superphosphate **2033** and **2115** both from stock of Wilson and Burr, Middletown. It was claimed that the first sample, drawn April 14, misrepresented the goods and therefore another sample **2115** was drawn in August which had a very different composition and higher valuation. It represented, however, a different lot of goods which were received from the manufacturer later in the season.

Two analyses of the Economical Bone Fertilizer **1997** and **2016** illustrate the varying quality of this brand. In one case the percentage difference between cost and valuation is 48 per cent., in the other 68 per cent.

The dealer's cash price for Acme Fertilizer No. 2, No. **2038**, page 39, should be $45 instead of $47.

The manufacturer of Acme Fertilizer No. 1, Nos. **2111** and **2037**, page 47, calls attention to the fact that analysis No. **2037**, which was made on a sample drawn from a single ton of stock, does not represent the general character of the goods, being lower in potash and higher in nitrogen than the goods average.

With the nitrogenous superphosphates, should be classed **2029** Bowker's Dry Ground Fish. In this brand only nitrogen is guaranteed. The analysis was made on a mixture of two samples, one from T. Pease and Sons Co., Windsor Locks, cost $40, the other from H. K. Brainard, Thompsonville, cost $38. The mixture contained 8.31 per cent. of nitrogen, guaranteed 8.0.

*Fish and Potash.*—This brand has been for a long time a popular one in this state and for ready comparison the different brands are tabulated by themselves on page 37.

Their average cost is $31.86, valuation $25.25 and per cent. difference between cost and valuation, 26.1, about the same as that of other nitrogenous superphosphates. Most of them are not, as the name properly implies, simple mixtures of fish scrap and potash salts, but contain considerable quantities of added phosphates. In three cases a large proportion of the phosphoric acid is insoluble.

### 2. *Difference between Cost and Valuation.*

Leaving out the last three analyses in the tables, whose percentage difference is over 50 per cent., the average cost of 63 superphosphates has been $35.74, the average valuation $28.45. The difference is $7.29, and the percentage difference 25.62. This means that the same quantities of nitrogen, phosphoric acid and potash, which were contained in a ton of the average superphosphate, could be bought in ton lots in this State for $28.45 cash, that the price asked for them in mixed goods was $35.74 and hence that mixing, bagging, selling and profits required an addition of 25.62 per cent. to the cost of the materials themselves.

### 3. *Guarantees.*

In nineteen brands the percentage of one ingredient was more than two-tenths per cent. below the minimum guarantee and in four brands two ingredients were thus deficient.

In most cases the deficit was on potash and came about by an inaccurate (and in this State illegal) method of stating the guarantee. The law provides that the guarantee shall be "expressed in the terms and manner approved and currently employed by the Connecticut Agricultural Experiment Station." The terms and manner of statement have been clearly set forth in the reports of this Station from the time the law went into force. The amount of *actual potash* must be stated. If desired, the equivalent of sulphate of potash may also be given. The phrase "Potash [sulphate] 4.0 per cent." correctly understood, means 4.0 per cent. of actual potash in the form of sulphate and not 4.0 per cent. of sulphate of potash which contains but little more than half its weight of actual potash.

## FISH AND POTASH.—SAMPLED BY THE STATION.

| | Quinnipiac Plain Brand. | Kelsey's. | Bradley's Triangle A. | Bowker's. | Miles'. | Pacific Guano Co's. | Quinnipiac, Crossed Fishes Brand. | Chittenden's. | Miles'. | Orient. | E. F. Coe's. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2064** | **1957** | **2052** | **2028** | **2095** | **2047** | **1999** | **2022** | **2042** | **2075** | **2053** |
| Nitrogen as Ammonia | .65 | .... | .69 | .... | .32 | .37 | .65 | .21 | .... | .44 | .... |
| Nitrogen, Organic | 3.15 | 3.78 | 3.09 | 2.54 | 2.27 | 1.97 | 3.46 | 3.32 | 2.23 | 2.99 | 2.36 |
| Soluble Phosphoric Acid | 1.01 | 1.17 | 2.80 | 1.86 | 6.44 | 4.89 | .91 | .65 | 7.56 | 3.24 | 3.02 |
| Reverted Phosphoric Acid | 4.33 | 1.77 | 3.34 | 2.92 | .68 | 3.22 | 4.73 | 5.02 | .67 | .90 | 2.86 |
| Insoluble Phosphoric Acid | 1.86 | .24 | 2.53 | 7.96 | .28 | 1.39 | 1.75 | 3.29 | .28 | .32 | 2.65 |
| Potash | 4.83 | 3.32 | 3.99 | 4.19 | 4.53 | 4.92 | 5.02 | 4.82 | 3.51 | 9.11 | 3.60 |
| Cost | $28.00 | $22.00 | $33.00 | $30.00 | $30.00 | $32.50 | $36.00 | $34.50 | $32.00 | $37.50 | $35.00 |
| Valuation | $26.65 | $20.72 | $27.63 | $24.59 | $24.41 | $25.85 | $28.27 | $27.00 | $24.14 | $26.47 | $22.03 |
| Nitrogen found | 3.80 | 3.78 | 3.78 | 2.54 | 2.59 | 2.34 | 4.11 | 3.53 | 2.23 | 3.43 | 2.36 |
| Nitrogen guaranteed | 2.00 | 2.50 | 2.00 | 2.30 | 2.50 | 2.50 | 3.30 | 3.30 | 2.50 | 3.00 | 3.30 |
| Phosphoric Acid found | 7.20 | 3.18 | 8.67 | 12.74 | 7.40 | 9.50 | 7.39 | 8.96 | 8.51 | 4.46 | 8.53 |
| Phosphoric Acid guaranteed | 6.00 | 3.00 | 6.00 | 8.00 | .... | 6.00 | 5.00 | 6.00 | .... | .... | .... |
| Potash found | 4.83 | 3.32 | 3.99 | 4.19 | 4.53 | 4.92 | 5.02 | 4.82 | 3.51 | 9.11 | 3.60 |
| Potash guaranteed | 4.00 | 3.00 | 4.00 | 4.00 | *3.00 | 4.00 | 3.00 | 5.00 | *3.00 | *14.00 | *4.00 |

* As Sulphate.

## NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| 2010 | Quinnipiac Dry Ground Fish. | Quinnipiac Co., New London, Ct. | R. B. Bradley & Co., New Haven. | - - - - | $37.00 |
| | | | Olds & Whipple, Hartford, | $37.00 | |
| | | | D. C. Wood, Stratford. | 38.00 | |
| 1912 | Fish Scrap. | | L. Sanderson, Long Wharf, New Haven. | 35.00 | 35.00 |
| 1918 | Swift Sure Superphosphate. | M. L. Shoemaker & Co., Phila. | F. Ellsworth, Hartford. | 38.00 | 38.00 |
| 2046 | Fish and Potash, Plain Brand. | Quinnipiac Co., New London, Ct. | Wilson & Burr, Middletown. | 28.00 | 28.00 |
| | | | P. & G. M. Williams, New London. | 26.00 | |
| | | | R. B. Bradley & Co., New Haven. | - - - - | |
| 1957 | Kelsey's Fish and Potash. | E. R. Kelsey, Branford, Conn. | M. S. Baldwin, Meriden. | 22.00 | - - - - |
| 2079 | Pure Fine Bone Dissolved in Sulphuric Acid. | Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y. | Mapes' Branch, Hartford. | 35.00 | 35.00 |
| | | | Strong & Backus, Colchester. | 36.00 | |
| 2065 | Peruvian Guano, Cargo Jonas. | Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y. | Mapes' Branch, Hartford. | 47.00 | 47.00 |
| 1969 | Quinnipiac Phosphate. | Quinnipiac Co., New London, Ct. | R. B. Bradley & Co., New Haven. | - - - - | 36.00 |
| | | | E. A. Godfrey, Southport. | 36.00 | |
| | | | D. B. Mansfield, Campville. | 36.00 | |
| | | | J. F. Silliman, New Canaan. | 38.00 | |
| | | | R. N. Birchard, Darien. | 38.00 | |
| 1965 | A. A. Ammoniated Superphosphate. | H. J. Baker & Bro., 215 Pearl St., New York. | R. B. Bradley & Co., New Haven. | - - - - | 37.00 |
| | | | C. O. Jelliff & Co., Southport. | 37.50 | |
| | | | Dennis Fenn, Milford. | 37.50 | |
| | | | Allen Betts, Norwalk. | 37.00 | |
| | | | S. J. Hall, Meriden. | 37.50 | |
| 2025 | Standard Superphosphate of Lime. | Lister Fertilizer and Chemical Works, Newark, N. J. | E. A. Brock & Co., Willimantic. | - - - - | 35.00 |
| | | | J. O. Fox & Co., Putnam. | 35.00 | |
| | | | S. J. Hall, Meriden. | 31.00 | |
| | | | A. N. Clark, Milford. | 32.00 | |
| | | | Martin Bros., Wallingford. | 32.00 | |

## NITROGENOUS SUPERPOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| **1988** | Farmer's New Method Fertilizer. | Bradley Fertilizer Co., 27 Kilby St., Boston, Mass. | T. Pease & Sons Co., Windsor Locks. | $34.00 | $34.00 |
| | | | Strong & Tanner, Winsted. | 34.20 | |
| | | | D. N. Clark & Sons, Milford. | 34.00 | |
| | | | Beach & Son, New Milford. | 35.00 | |
| | | | J. L. Butler, Torrington. | .... | |
| **2038** | Acme Fertilizer, No. 2. | C. Meyer, Jr., Maspeth, L. I. | A. S. Russell & Co., Meriden. | 47.00 | 45.00 |
| | | | J. H. Ives, Danbury. | 45.00 | |
| **2052** | Fish and Potash, Triangle A Brand. | Bradley Fertilizer Co., 27 Kilby St., Boston, Mass. | A. H. Dimond, Bethel. | 33.00 | .... |
| **2045** | Pine Island Phosphate. | Quinnipiac Co., New London, Conn. | H. J. Standift, New Hartford. | 30.00 | 32.00 |
| | | | D. C. Wood, Stratford. | 30.00 | |
| **2011** | Mapes' Complete Manure for General Use. | Mapes' Formula and Peruvian Guano Co., 158 Front St., N. Y. | R. B. Bradley & Co., New Haven. | .... | 41.00 |
| | | | Mapes' Branch, Hartford. | 41.00 | |
| | | | Birdsey & Foster, Meriden. | 42.50 | |
| | | | Southington Lumber and Feed Co., Southington. | 41.50 | |
| | | | J. O. Fox & Co., Putnam. | 41.00 | |
| | | | Dunham & Co., Cheshire. | 42.00 | |
| | | | Dean & Horton, Stamford. | 42.00 | |
| **1971** | Americus Brand, Ammoniated Bone Superphosphate. | Williams & Clark Co., Hanover Square, New York. | J. F. Silliman, New Canaan. | 38.00 | 36.00 |
| | | | Atwood & Wilson, Watertown. | 36.00 | |
| | | | E. M. Jennings, Southport. | 35.00 | |
| | | | R. B. Bradley & Co., New Haven. | .... | |
| | | | Soule & Staub, New Milford. | 38.00 | |
| **2108** | Chittenden's Ammoniated Bone Superphosphate. | National Fertilizer Co., Bridgeport, Conn. | G. W. Eaton, Plainville. | 34.00 | .... |
| | | | W. W. Cooper, Suffield, | 34.00 | |
| | | | L. N. Currier, Bridgeport. | 35.00 | |

## NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| 2028 | Fish and Potash. | Bowker Fertilizer Co., 43 Chatham Street, Boston, Mass. | T. Pease & Sons Co., Windsor Locks. | $33 00 | $30.00 |
| | | | H. K. Brainard, Thompsonville. | 30.00 | |
| | | | Dunham & Co., Cheshire. | 33.00 | |
| 2111 | Acme Fertilizer, No. 1. | C. Meyer, Jr., Maspeth, Long Island. | A. S. Russell & Co., Meriden. | 45.00 | 45.00 |
| 1972 | Extra Fine Ground Bone with Potash, Circle Brand. | Bradley Fertilizer Co, 27 Kilby Street, Boston, Mass. | Lockwood Bros., Watertown. | 32.00 | 32.00 |
| | | | Charles Jennings & Son, Southport. | 33.00 | |
| | | | J. L. Butler, Torrington. | 35.00* | |
| 2095 | Fish and Potash. | G. W. Miles, Agent for John Guyer, Milford, Conn. | John Guyer, New Haven. | 30.00 | 30.00 |
| 1985 | High Grade Ammoniated Bone Phosphate. | E. F. Coe, 16 Burling Slip, New York. | Manufacturer.† | 35.00 | 35.–38.00 |
| 2037 | Acme Fertilizer, No. 1. | C. Meyer, Jr., Maspeth, L. I. | J. H. Ives, Danbury. | 45.00 | 45.00 |
| 2008 | Mapes' Complete Manure for Light Soil. | Mapes' Formula & Peruvian Guano Co., 158 Front Street, New York. | Dean & Horton, Stamford. | 46.00 | 45.00 |
| | | | R. B. Bradley & Co., New Haven. | 45.00 | |
| | | | Birdsey & Foster, Meriden. | 46.50 | |
| | | | D. B. Beadsley, Southport. | 45.00 | |
| | | | Wilson & Burr, Middletown. | 45.00 | |
| | | | Mapes' Branch, Hartford. | 45.00 | |
| 1968 | Chittenden's Complete Manure. | National Fertilizer Co., Bridgeport, Conn. | Allen Betts, Norwalk. | 43.00 | .... |
| | | | W. W. Cooper, Suffield. | 45.00 | |
| | | | L. N. Currier, Bridgeport. | 45.00 | |
| 2034 | Darling's Animal Fertilizer. | L. B. Darling & Co., Pawtucket, R. I. | J. M. Belden, New Britain. | 40.00 | 38.00 |
| | | | Dunham & Co., Cheshire. | 37.50 | |
| | | | E. F. Davis, Plainville. | 38.00 | |
| | | | Olds & Whipple, Hartford. | 40.00 | |
| | | | J. W. Cutler, Putnam. | 38 00 | |
| | | | L. A. Hall, South Coventry. | 38.00 | |
| | | | N. C. Barker & Co., Lebanon. | 38.00 | |

* Sold in small lots.

† Sampled from a lot bought by a number of farmers in Middlefield.

## NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| **2023** | Bay State Fertilizer. | Clark's Cove Guano Co., New Bedford, Mass. | J. B. Carman, South Coventry. | $38.00 | .... |
| | | | R. H. Hall, East Hampton. | 38.00 | |
| | | | E. C. Dennis, Stafford. | 38.00 | |
| | | | J. H. Ives, Danbury. | 40.00 | |
| | | | A. L. Chamberlain, Fair Haven. | 36.00 | |
| **2047** | Fish and Potash. | Soluble Pacific Guano Co., Boston, Mass. | W. H. Tucker, Lebanon. | 32.00 | .... |
| | | | B. Curtis & Son, Stepney Depot. | 33.00 | |
| **1999** | Fish and Potash, Crossed Fishes Brand. | Quinnipiac Co., New London, Conn. | J. F. Silliman, New Canaan. | 38.00 | $35.00 |
| | | | S. N. Osborn, Easton. | 38.00 | |
| | | | Wilson & Burr, Middletown. | 35.00 | |
| | | | D. B. Mansfield, Campville. | 36.00 | |
| | | | R. B. Bradley & Co., New Haven. | 35.00 | |
| | | | Olds & Whipple, Hartford. | 37.00 | |
| **1966** | High Grade Ammoniated Bone Superphosphate. | E. F. Coe, 16 Burling Slip, New York. | Wheeler & Howes, Bridgeport. | 35.00 | 35.–38.00 |
| | | | Simon Banks, Southport. | 34.00 | |
| | | | Allen Betts, Norwalk. | 33.00 | |
| | | | Walker & Nutting, Waterbury. | 38.00 | |
| **2022** | Chittenden's Fish and Potash. | National Fertilizer Co., Bridgeport, Conn. | W. W. Cooper, Suffield. | 35.00 | .... |
| | | | G. W. Eaton, Plainville. | 34.00 | |
| | | | T. H. Eldredge, Norwich. | 35.00 | |
| | | | David Fitzgerald, Stratford. | 33.25 | |
| **2119** | Victor Phosphate. | Made for the Apothecaries Hall Co., Waterbury. | Apothecaries Hall Co., Waterbury. | 26.00 | .... |
| **2074** | Darling's Extra Phosphate. | L. B. Darling Fertilizer Co., Pawtucket, R. I. | J. P. Barstow & Co., Norwich. | 36 00 | 38.00 |
| | | | Olds & Whipple, Hartford. | 38.00 | |
| **2032** | Unicorn Ammoniated Superphosphate. | Clark's Cove Guano Co., New Bedford, Mass. | A. L. Chamberlain, Fair Haven. | 34.20 | .... |

## NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| **2003** | Ammoniated Bone Superphosphate. | Crocker Fertilizer and Chemical Works, Buffalo, N. Y. | J. M. Belden, New Britain. | $40.00 | ---- |
| | | | J. H. Reay, Greenwich. | 35.00 | |
| | | | E. T. Morehouse, New Hartford. | 40.00 | |
| | | | Sherman Foote, Brookfield Centre. | 35.00 | |
| **2018** | Pelican Bone Fertilizer. | H. J. Baker & Bro., 215 Pearl St., New York. | Dennis Fenn, Milford. | 32.50 | $32.50 |
| | | | Jas. Greenfield, New London. | 32.50 | |
| **1975** | Patent Superphosphate of Lime. | Bradley Fertilizer Co., 27 Kilby St., Boston, Mass. | Beach & Son, New Milford. | 38.00 | 37–38 |
| | | | Peck Bros., Northfield. | 38.00 | |
| | | | Lockwood Bros., Watertown. | 36.00 | |
| | | | J. L. Butler, Torrington. | ---- | |
| | | | D. N. Clark & Sons, Milford. | 37.00 | |
| | | | O. A. Hubbell, Harwinton. | ---- | |
| | | | Wilson & Burr, Middletown. | 38.00 | |
| | | | Walker & Nutting, Waterbury. | 38.00 | |
| | | | Raymond Bros., Norwalk. | 38.00 | |
| | | | Strong & Tanner, Winsted. | 38.00 | |
| | | | A. A. Hubbard, Canaan. | 38.00 | |
| **2009** | Mapes' Complete Manure, A Brand. | Mapes' Formula and Peruvian Guano Co., 158 Front St., New York. | Southington Lumber and Feed Co., Southington. | 38.50 | 38.00 |
| | | | Dunham & Co., Cheshire. | 39.00 | |
| | | | J. E. Dean, Winsted. | 40.00 | |
| | | | A. F. Roberts, Lakeville. | 38.00 | |
| | | | J. O. Fox & Co., Putnam. | 40.00 | |
| | | | Birdsey & Foster, Meriden. | 39.50 | |
| | | | Dean & Horton, Stamford. | 40.00 | |
| | | | Mapes' Branch, Hartford. | 38.00 | |
| | | | Wilson & Burr, Middletown. | 38.00 | |
| | | | R. B. Bradley & Co., New Haven | 38.00 | |

## NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| 2019 | Hill and Drill Phosphate. | Bowker Fertilizer Co., 43 Chatham St., Boston, Mass. | Dunham & Co., Cheshire. | $40.00 | $36.00 |
| | | | Brewster & Burnett, Norwich. | 38.00 | |
| | | | Southington Lumber and Feed Co., Southington. | 37.50 | |
| | | | R. S. Converse, Stafford. | 38.00 | |
| | | | Jas. Greenfield, New London. | 37.50 | |
| 2020 | Bowker Ammoniated Bone Phosphate. | Bowker Fertilizer Co., 43 Chatham St., Boston, Mass. | Dunham & Co., Cheshire. | 35.00 | 32.00 |
| | | | Jas. Greenfield, New London. | 35.00 | |
| | | | Hubbell & Bradley, Saugatuck. | 32.00 | |
| | | | Brewster & Burnett, Norwich. | 38.00 | |
| 2044 | Ammoniated Bone Superphosphate. | Preston Fertilizer Co., Greenpoint, Brooklyn, L. I. | A. L. Hodges, Roxbury Station. | 33.00 | .... |
| | | | J. B. Merrow & Sons, Merrow Station. | 34.00 | |
| 2115 | Ammoniated Superphosphate. | Russell Coe, Tremley, N. J. | Wilson & Burr, Middletown. | 30.00 | .... |
| 2042 | Fish and Potash. | G. W. Miles, Milford. | Simon Banks, Southport. | 32.00 | |
| 1974 | Alkaline Bone. | E. Frank Coe., 16 Burling Slip, New York. | Wheeler & Howes, Bridgeport. | 35.00 | 32–34 |
| | | | J. F. Silliman, New Canaan. | 32.00 | |
| | | | Allen Betts, Norwalk. | 29.00 | |
| 2014 | Cumberland Superphosphate. | Cumberland Bone Co., Portland, Me. | C. P. Capron, Norwich Town. | 38.00 | 38.00 |
| | | | Brainard & Childs, New London. | 40.00 | |
| | | | J. W. Cutler, Putnam. | 38.00 | |
| 2021 | Original Coe's Superphosphate of Lime. | Bradley Fertilizer Co., 27 Kilby St., Boston, Mass. | T. Pease & Sons Co., Windsor Locks. | 36.00 | 34–35 |
| 2013 | Improved Blood Guano. | Dambmann Bros. (Ed. F. Cook, Agt.), Baltimore, Md. | W. Dudley, Guilford. | 35.00 | 30–35 |
| | | | Champion & Caulkins, Lyme. | 35.00 | |
| 2048 | Royal Bone. | Williams & Clark Co., Hanover Square, New York City. | Hale, Day & Co., So. Manchester. | 30.00 | .... |
| | | | L. W. Dart, Niantic. | 30.00 | |
| | | | Strong & Backus, Colchester. | 29.00 | |
| | | | A. P. Smith & Sons, Lebanon. | 27.00 | |

## NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| **1987** | Standard Superphosphate. | Standard Fertilizer Co., 118½ Milk St., Boston, Mass. | Allen Wilson, Suffield. | $38.00 | .... |
| **1977** | Good Luck Guano. | R. J. Ruth & Co., New York. | H. J. Mattoon, Watertown.<br>H. L. Hall, 2d, Wallingford. | 36.00<br>36.00 | .... |
| **2031** | Great Planet A. Manure. | Clark's Cove Guano Co., New Bedford. | J. H. Ives, Danbury<br>A. L. Chamberlain & Co., Fair Haven. | 46.00<br>45.60 | .... |
| **2067** | Cecrops or Dragon Tooth Fertilizer. | Newton & Ludlam, 182 Front St., New York. | D. N. Benton, Guilford. | 41.50 | .... |
| **2024** | Common Sense Fertilizer, No. 2. | Common Sense Fertilizer Co., 42 Congress St., Boston, Mass. | E. Fly, Putnam.<br>W. H. Cardwell, Norwich.<br>Jas. Greenfield, New London. | 35.00<br>35.00<br>35.00 | .... |
| **2066** | Cereal Fertilizer. | Newton & Ludlam, 182 Front St., New York. | J. E. Littlefield, Niantic.<br>D. N. Benton, Guilford. | 34.00<br>31.50 | .... |
| **2088** | I. X. L. Ammoniated Superphosphate. | G. W. Miles, Agent, Milford, Conn. | John Guyer, New Haven. | 33.00 | $33.00 |
| **1986** | Red Brand Excelsior Guano. | E. Frank Coe, 16 Burling Slip, New York. | Manufacturer.* | 45.00 | 45.00 |
| **2075** | Fish and Potash. | Orient Guano Manufacturing Co., Orient, L. I. | J. E. Dean, Winsted. | 37.50 | .... |
| **2033** | Ammoniated Bone Superphosphate. | Russell Coe, Tremley, N. J. | Wilson & Burr, Middletown. | 30.00 | .... |
| **2039** | I. X. L. Ammoniated Bone Superphosphate. | G. W. Miles, Milford, Conn. | W. Sardam, Canaan.<br>Platt & Merwin, Milford.<br>J. P. Barstow, Norwich. | 36.00<br>30.00<br>32.00 | .... |

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* Sampled from a lot bought by a number of farmers in Middlefield.

## NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| **1970** | Soluble Pacific Guano. | Glidden & Curtis, Agents, Boston, Mass. | Wm. M. Perry & Co., Stratford. | 38 00 | .... |
| | | | H. A. Stillman, Hartford. | 38.00 | |
| | | | A. A. Hubbard, Canaan. | 38.00 | |
| | | | Balch & Platt, W. Winsted. | 38.00 | |
| | | | Talcott & Alvord, Torrington. | 37.00 | |
| **2043** | Standard Superphosphate. | A. Mitchell, Tremley Pt., Staten Island. | Hull & Sweet, Coventry. | 38.00 | $36.00 |
| **2015** | Orient Complete Manure. | Orient Guano Co., Orient, L. I. | J. E. Dean, Winsted. | 30.00 | .... |
| | | | M. G. Morse, Guilford. | 30.00 | |
| | | | G. W. Eaton, Plainville. | 33.00 | |
| **1997** | Economical Bone Fertilizer. | Wilkinson & Co., 239 Center St., New York. | G. H. Loomis, Chestnut Hill. | 35.00 | .... |
| **2053** | High Grade Fish Guano and Potash. | E. Frank Coe, 16 Burling Slip, New York. | Hall, Hornbeck & Co., Falls Village. | 35.00 | .... |
| **2016** | Economical Bone Fertilizer. | Wilkinson & Co., 239 Center St., New York. | A. L. Anderson & Son, Tolland. | 32.00 | .... |
| **1996** | Ammoniated Superphosphate. | Wilkinson & Co., 239 Center St., New York. | Ferris & Nolan, Stamford. | 38.00 | .... |

## ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION.

| Station No. | Name or Brand. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Available. | | | | | | | |
| | | Nitrogen as Nitrates. | Nitrogen as Ammonia. | Nitrogen, Organic. | Total Nitrogen Found. | Nitrogen Guaranteed. | Soluble. | Reverted. | Insoluble. | Total Found | Total Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. | Chlorine. | Cost per ton. | Valuation per Ton. | Percentage Difference between Cost and Valuation. |
| 2010 | Quinnipiac Dry Ground Fish | .... | .... | 8.97 | 8.97 | 7.5 | .80 | 5.50 | .88 | 7.18 | .... | 6.30 | 4.0 | .... | .... | .... | $37.00 | $41.46 | 10.7† |
| 1912 | Sanderson's Fish Scrap .... | .... | .... | 7.96 | 7.96 | 6.6 | .98 | 3.95 | 1.35 | 6.28 | 6.0 | 4.93 | .... | .... | .... | .... | 35.00 | 36.16 | 3.2† |
| 1918 | Swift Sure Superphosphate | .74 | .... | 2.45 | 3.19 | 2.5 | 9.06 | 3.45 | 2.27 | 14.78 | .... | 12.51 | 9.0 | 4.79 | 4.0* | trace | 38.00 | 37.25 | 2.0 |
| 2046 | Fish and Potash, Plain Brand | .... | .65 | 3.15 | 3.80 | 2.0 | 1.01 | 4.33 | 1.86 | 7.20 | 6.0 | 5.34 | 4.0 | 4.83 | 4.0 | 7.91 | 28.00 | 26.65 | 5.0 |
| 1957 | Kelsey's Fish and Potash.. | .... | .... | 3.78 | 3.78 | 2.5 | 1.17 | 1.77 | .24 | 3.18 | 3.0 | 2.94 | .... | 3.32 | 3.0 | 2.94 | 22.00 | 20.72 | 6.1 |
| 2079 | Mapes' Pure Fine Bone Dissolved in Sulphuric Acid. | .... | .... | 1.89 | 1.89 | 2.1 | 5.76 | 10.88 | .76 | 17.40 | .... | 16.64 | 12.0 | .... | .... | .... | 35.00 | 32.62 | 8.8 |
| 2065 | Peruvian Guano, cargo Jonas | .11 | 2.13 | 1.05 | 3.29 | 3.9 | 4.23 | 9.90 | 8.19 | 22.32 | 22.9 | 14.13 | .... | 5.01 | 2.6 | 2.25 | 47.00 | 42.77 | 9.8 |
| 1969 | Quinnipiac Phosphate..... | .51 | trace | 2.73 | 3.24 | 2.7 | 7.24 | 4.37 | 1.83 | 13.44 | .... | 11.61 | 9.0 | 2.61 | 2.0 | 2.61 | 36.00 | 32.65 | 10.2 |
| 1965 | Baker's A. A. Ammoniated Superphosphate ........ | .... | 2.87 | .50 | 3.37 | 2.5 | 11.73 | .44 | .13 | 12.30 | .... | 12.17 | 10.0 | 2.94 | 2.0 | 3.19 | 37.50‡ | 33.80 | 10.9 |
| 2025 | Lister's Standard Superphosphate of Lime.......... | .... | 1.20 | .96 | 2.16 | 2.3 | 10.59 | 1.07 | .70 | 12.36 | .... | 11.66 | 10.0 | 1.63 | 1.5 | 1.17 | 32.50 | 27.92 | 16.4 |
| 1988 | Farmer's New Method Fert'r | .... | .14 | 2.29 | 2.43 | 1.7 | 8.36 | 1.68 | 2.56 | 12.60 | 10.0 | 10.04 | 8.0 | 3.32 | 3.0 | 3.02 | 34.00 | 28.77 | 18.2 |
| 2038 | Acme Fertilizer, No. 2 .... | .... | 4.94 | .58 | 5.52 | 5.0 | 7.09 | 1.13 | .21 | 8.43 | 8.5 | 8.22 | 8.0 | 6.35 | 5.0 | 4.99 | 45.00 | 37.89 | 18.8 |
| 2052 | Fish and Potash, Triangle A Brand................ | .... | .69 | 3.09 | 3.78 | 2.0 | 2.80 | 3.34 | 2.53 | 8.67 | 6.0 | 6.14 | 4.0 | 3.99 | 4.0 | 5.02 | 33.00 | 27.63 | 19.5 |
| 2015 | Pine Island Phosphate..... | .... | .45 | 1.98 | 2.43 | 2.0 | 5.78 | 4.25 | 1.31 | 11.34 | .... | 10.03 | 9.0 | 1.94 | 1.0 | 2.99 | 32.00 | 26.57 | 20.4 |
| 2011 | Mapes' Complete for General Use ............... | .79 | .91 | 1.92 | 3.62 | 3.3 | 5.44 | 4.12 | 3.78 | 13.34 | 10.0 | 9.56 | .... | 4.87 | 4.0 | 3.21 | 41.00 | 33.88 | 21.0 |
| 1971 | Americus Brand Ammoniated Bone Superphosp'ate | .... | .79 | 1.87 | 2.66 | 2.0 | 9.20 | 1.71 | .55 | 11.46 | 11.0 | 10.91 | .... | 2.49 | 2.0 | trace | 36.00 | 29.67 | 21.3 |
| 2108 | Chittenden's Ammoniated Bone Superphosphate ... | .08 | .... | 2.48 | 2.56 | 1.7 | 7.22 | 3.18 | 1.57 | 11.97 | 9.0 | 10.40 | 7.0 | 1.99 | 2.0 | 2.53 | 34.00 | 27.89 | 21.9 |

* As Sulphate. † Valuation exceeds Cost. ‡ Manufacturer quotes $37, which would make the percentage difference 9.4.

## ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | Chlorine. | Cost per Ton. | Valuation per Ton. | Percentage Difference between Cost and Valuation. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nitrogen as Nitrates. | Nitrogen as Ammonia. | Nitrogen, Organic. | Total Nitrogen Found. | Nitrogen Guaranteed. | Soluble. | Reverted. | Insoluble. | Total Found | Total Guaranteed. | Available. | | Found. | Guaranteed. | | | | |
| | | | | | | | | | | | | Found. | Guaranteed. | | | | | | |
| 2028 | Bowker's Fish and Potash | .... | .... | 2.54 | 2.54 | 2.3 | 1.86 | 2.92 | 7.96 | 12.74 | 8.0 | 4.78 | .... | 4.19 | 4.0 | 3.83 | $30.00 | $24.59 | 22.0 |
| 2111 | Acme Fertilizer, No. 1 | .... | 3.25 | 1.12 | 4.37 | 3.7 | 7.72 | .31 | .05 | 8.08 | .... | 8.03 | 8.0 | 10.12 | 9.0 | 9.03 | 45.00 | 36.75 | 22.4 |
| 1972 | Extra Fine Ground Bone with Potash, Circle brand | .... | .... | 2.04 | 2.04 | 1.9 | 3.00 | 5.16 | 5.42 | 13.58 | 8.0 | 8.16 | .... | 3.74 | 2.0 | 5.99 | 32.00 | 26.11 | 22.5 |
| 2095 | Miles' Fish and Potash | .... | .32 | 2.27 | 2.59 | 2.5 | 6.44 | .68 | .28 | 7.40 | .... | 7.12 | 5.0 | 4.53 | 3.0* | 3.56 | 30.00 | 24.41 | 22.9 |
| 1985 | High Grade Ammoniated Bone Phosphate | .... | .95 | 1.37 | 2.32 | 2.1 | 9.12 | 1.75 | 1.18 | 12.05 | 11.0 | 10.87 | 9.0 | 2.17 | 3.0* | .22 | 35.00 | 28.36 | 23.4 |
| 2037 | Acme Fertilizer, No. 1 | .... | 3.98 | .67 | 4.65 | 3.7 | 7.36 | 1.06 | .23 | 8.65 | .... | 8.42 | 8.0 | 7.67 | 9.0 | 5.14 | 45.00 | 36.31 | 23.9 |
| 2008 | Mapes' Complete for Light Soils | 1.37 | 2.59 | 1.41 | 5.37 | 5.0 | 2.97 | 3.20 | 3.31 | 9.48 | 7.0 | 6.17 | .... | 7.50 | 6.0 | 6.62 | 45.00 | 36.30 | 23.9 |
| 1968 | Chittenden's Complete Fertilizer | .30 | .65 | 2.97 | 3.92 | 3.7 | 4.90 | 4.87 | 4.71 | 14.48 | 8.0 | 9.77 | 6.0 | 5.07 | 6.0 | 2.91 | 45.00 | 36.22 | 24.2 |
| 2034 | Darling's Animal Fertilizer | .45 | .37 | 2.83 | 3.65 | 3.3 | 2.68 | 4.65 | 3.63 | 10.96 | 10.0 | 7.33 | .... | 5.19 | 4.0 | 5.54 | 38.00 | 30.50 | 24.6 |
| 2023 | Bay State Fertilizer | .... | .91 | 1.70 | 2.61 | 2.0 | 8.68 | 2.05 | 1.88 | 12.61 | 10.0 | 10.73 | 8.0 | 2.95 | 2.0 | .76 | 38.00 | 30.22 | 25.7 |
| 2047 | Pacific Guano Co's Fish and Potash | .... | .37 | 1.97 | 2.34 | 2.5 | 4.89 | 3.22 | 1.39 | 9.50 | 6.0 | 8.11 | 4.0 | 4.92 | 4.0 | 8.69 | 32.50 | 25.85 | 25.7 |
| 1999 | Fish and Potash, Crossed Fishes Brand | .... | .65 | 3.46 | 4.11 | 3.3 | .91 | 4.73 | 1.75 | 7.39 | 5.0 | 5.64 | 3.0 | 5.02 | 3.0 | 6.18 | 36.00 | 28.27 | 27.3 |
| 1966 | E. F. Coe's Ammoniated Bone Superphosphate | .... | .56 | 1.70 | 2.26 | 2.0 | 8.26 | 2.02 | 1.91 | 12.19 | 11.0 | 10.28 | 9.0 | 1.96 | 3.0* | trace | 35.00 | 27.47 | 27.4 |
| 2032 | Chittenden's Fish and Pot'sh | .... | .21 | 3.32 | 3.53 | 3.3 | .65 | 5.02 | 3.29 | 8.96 | 6.0 | 5.67 | .... | 4.82 | 5.0 | 9.22 | 34.50 | 27.00 | 27.7 |
| 2119 | Victor Phosphate | .... | .... | 1.07 | 1.07 | .... | 7.04 | 1.72 | 1.21 | 9.97 | .... | 8.76 | .... | 2.36 | .... | 2.49 | †26.00 | 20.33 | 27.8 |
| 2074 | Darling's Extra Phosphate | .41 | .57 | 1.85 | 2.83 | 2.5 | 6.23 | 3.47 | 1.60 | 11.30 | 10.0 | 9.70 | 7.0 | 3.33 | 3.0 | 3.19 | 37.00 | 28.75 | 28.7 |

* As Sulphate.

† See Explanatory note in this Bulletin.

## ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | Chlorine. | Cost per Ton. | Valuation per Ton. | Percentage Difference between Cost and Valuation. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nitrogen as Nitrates. | Nitrogen as Ammonia. | Nitrogen, Organic. | Total Nitrogen Found. | Nitrogen Guaranteed. | Soluble. | Reverted. | Insoluble. | Total Found. | Total Guaranteed. | Available. | | Found. | Guaranteed. | | | | |
| | | | | | | | | | | | | Found. | Guaranteed. | | | | | | |
| 2032 | Unicorn Ammoniated Superphosphate | .... | .05 | 2.18 | 2.23 | 2.1 | 6.32 | 3.15 | 2.67 | 12.14 | 10.0 | 9.47 | 8.5 | 2.56 | 2.3 | 1.70 | $34.20 | $26.49 | 29.1 |
| 2003 | Crocker's Bone Superphosphate | .... | trace | 3.11 | 3.11 | 2.9 | 7.87 | 1.96 | 1.25 | 11.08 | .... | 9.83 | 8.0 | 2.21 | 1.0* | 2.16 | 37.50 | 29.05 | 29.1 |
| 2018 | Polican Bone Fertilizer | .... | 1.67 | .69 | 2.36 | 1.9 | 8.60 | .41 | .11 | 9.12 | .... | 9.01 | 8.0 | 2.88 | 2.0 | 2.29 | 32.50 | 25.16 | 29.2 |
| 1975 | Bradley's Patent Superphosphate of Lime | .30 | .... | 2.55 | 2.85 | 2.3 | 8.05 | 2.12 | 2.38 | 12.55 | 11.0 | 10.17 | 9.0 | 1.91 | 1.5 | 1.93 | 37 50 | 29.00 | 29.3 |
| 2009 | Mapes' Complete Manure, A Brand | .78 | .60 | 1.16 | 2.54 | 2.5 | 5.71 | 4.56 | 3.32 | 13.59 | .... | 10.26 | 10.0 | 3.19 | 2.5 | 3.58 | 38.00 | 29.34 | 29.5 |
| 2019 | Hill and Drill Phosphate | .... | .23 | 2.33 | 2.56 | 2.5 | 8.45 | 2.23 | 3.19 | 13.87 | 12.0 | 10.68 | .... | 1.75 | 2.0 | 2.52 | 38.00‡ | 29.23 | 30.0 |
| 2020 | Bowker's Ammoniated Bone Phosphate | .... | .... | 1.95 | 1.95 | 2.0 | 8.74 | 1.36 | 1.99 | 12.09 | 11.0 | 10.10 | 10.0 | 1.57 | 2.0 | 1.79 | 33.00§ | 25.36 | 30.1 |
| 2044 | Preston's Bone Superphosphate | .... | .... | 2.57 | 2.57 | 2.5 | 5.35 | 1.99 | 2.83 | 10.17 | .... | 7.34 | 9.0 | 3.25 | 2.0 | .73 | 33.50 | 25.58 | 30.9 |
| 2115 | Russell Coe's Ammoniated Superphosphate | .... | .70 | 1.07 | 1.77 | 2.0 | 6.75 | 2.51 | .99 | 10.25 | 10.0 | 9.26 | 8.0 | 1.69 | 1.0 | 5.60 | 30.00 | 22.80 | 31.6 |
| 2042 | Miles' Fish and Potash | .... | .... | 2.23 | 2.23 | 2.5 | 7.56 | .67 | .28 | 8.51 | .... | 8.23 | 5.0 | 3.51 | 3.0* | 2.45 | 32.00 | 24.14 | 32.5 |
| 1974 | E. Frank Coe's Alkaline Bone | .... | .... | 1.22 | 1.22 | 1.0 | 7.30 | 2.74 | 2.90 | 12.94 | .... | 10.04 | 9.0 | 2.04 | 3.0* | trace | 32.00 | 24.04 | 33.1 |
| 2014 | Cumberland Superphosphate | .63 | .05 | 1.73 | 2.41 | 2.0 | 6.00 | 2.71 | 4.65 | 13.36 | 11.0 | 8.71 | 8.0 | 3.94 | 2.0 | 1.66 | 38.00 | 28.49 | 33.3 |
| 2021 | Original Coe's Superphosphate of Lime | .... | .... | 2.32 | 2.32 | 2.1 | 7.67 | 2.35 | 2.54 | 12.56 | 10.0 | 10.02 | 8.0 | 1.77 | 1.0 | 1.76 | 36.00† | 26.93 | 33.7 |
| 2013 | Improved Blood Guano | .66 | .55 | 1.11 | 2.32 | 1.6 | 7.44 | 2.16 | 1.21 | 10.81 | .... | 9.60 | 8.0 | 2.73 | 2.0 | 3.04 | 35.00 | 26.11 | 34.0 |
| 2018 | Royal Bone | .... | .... | 1.53 | 1.53 | .3 | 6.33 | 2.12 | .47 | 8.92 | 8.0 | 8.45 | .... | 2.54 | 2.0 | .36 | 29.00 | 21.63 | 34.0 |

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* As Sulphate.

† Manufacturer quotes $34.00, which would make the percentage difference 28.1.

‡ Manufacturer quotes $36.00, which would make the percentage difference 23.1.

§ Manufacturer quotes $32.00, which would make the percentage difference 26.1.

## ANALYSES OF NITROGENOUS SUPERPHOSPHATES AND GUANOS SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | Chlorine. | Cost per Ton. | Valuation per Ton. | Percentage Difference between Cost and Valuation. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nitrogen as Nitrates. | Nitrogen as Ammonia. | Nitrogen, Organic. | Total Nitrogen Found. | Nitrogen Guaranteed. | Soluble. | Reverted. | Insoluble. | Total Found. | Total Guaranteed. | Available. | | Found. | Guaranteed. | | | | |
| | | | | | | | | | | | | Found. | Guaranteed. | | | | | | |
| **1987** | Standard Superphosphate.. | .... | trace | 2.78 | 2.78 | 2.5* | 7.20 | 2.24 | 2 50 | 11.94 | 11.0 | 9.44 | 9.0 | 2.47 | 2.0 | 3.57 | 38.00 | 28.21 | 34.7 |
| **1977** | Good Luck Guano......... | .... | .51 | 1.68 | 2.19 | 2.5 | 8.19 | 1.86 | 1 24 | 11.29 | .... | 10.05 | 10.0 | 2.16 | 2.0 | 1.64 | 36.00 | 26.14 | 37.7 |
| **2031** | Great Planet A Manure... | .... | 1.54 | 1.80 | 3.34 | 3.3 | 5.47 | 2.43 | 1.39 | 9.29 | 8.3 | 7.90 | 7.0 | 9.54 | 9.5 | 6.65 | 46.00 | 33.22 | 38.5 |
| **2067** | Cecrops or Dragon Tooth Fertilizer.............. | .... | .90 | 1.81 | 2.71 | 3.3 | 7.52 | 1.52 | 2.77 | 11.81 | .... | 9.04 | 7.0 | 5.28 | 7.0 | 5.24 | 41.50 | 29.95 | 38.5 |
| **2024** | Common Sense Fertilizer, No. 2................ | .... | 2.61 | .73 | 3.34 | 2.0 | .21 | 5.54 | 3.30 | 9.05 | 4.0 | 5.75 | .... | 3.08 | 3.0 | 3.24 | 35.00 | 24.94 | 40.3 |
| **2066** | Cereal Fertilizer.......... | .... | .... | 1.40 | 1.40 | 1.5 | 7.83 | 2.01 | 2.52 | 12.36 | 12.0 | 9.84 | 10.0 | 1.59 | 4.0 | 2.11 | 32.75 | 23.31 | 40.5 |
| **2088** | I. X. L. Ammoniated Superphosphate.............. | .... | .23 | 1 83 | 2.06 | .... | 7.06 | 1.81 | .62 | 9.49 | .... | 8.87 | .... | 2.13 | .... | 2.99 | 33.00 | 23.41 | 40.9 |
| **1986** | Red Brand Excelsior Guano | .... | trace | 3.27 | 3.27 | 3.3 | 7.40 | 1.80 | 1.17 | 10.37 | 10.0 | 9.20 | .... | 4.88 | 11.0* | .52 | 45.00 | 31.89 | 41.1 |
| **2075** | Orient Fish and Potash.... | .... | .44 | 2.99 | 3.43 | 3.0 | 3.24 | .90 | .32 | 4.46 | .... | 4.14 | 5.0 | 9.11 | 14.0* | 8.48 | 37.50 | 26.47 | 41.6 |
| **2033** | Russell Coe's Ammoniated Superphosphate......... | .... | .... | .97 | .97 | 2.0 | 7.09 | 2.71 | 1.83 | 11.63 | 10.0 | 9.80 | 8.0 | 1.11 | 1.0 | 4.77 | 30.00 | 20.85 | 43.9 |
| **2039** | I. X. L. Ammoniated Bone Superphosphate......... | .... | .... | 1.58 | 1.58 | 2.1 | 6.98 | 2.33 | 1.15 | 10.46 | .... | 9.31 | 8.0 | 1.48 | 1.0* | 2.52 | 32.00 | 22.13 | 44.6 |
| **1970** | Soluble Pacific Guano...... | .... | .... | 2.22 | 2.22 | 2 0 | 6.82 | 2.21 | 3.40 | 12.43 | .... | 9.03 | 8.0 | 2.52 | 2.0 | 2.61 | 38.00 | 26.18 | 45.1 |
| **2043** | Mitchell's Superphosphate.. | .... | .... | 1.99 | 1.99 | 2.1 | 8.30 | 2.49 | 45 | 11.24 | 11.5 | 10.79 | 9.0 | 1.81 | 3.0 | trace | 38.00 | 25.80 | 47.3 |
| **2015** | Orient Complete Manure... | .... | .14 | 1.45 | 1.59 | 1.7 | 6.45 | 2.23 | 1.10 | 9.78 | .... | 8.68 | 8.0 | 1.24 | 2.0* | 1.47 | 31.00 | 20.95 | 47.9 |
| **1997** | Economical Bone Fertilizer. | .... | 1.59 | .49 | 2.08 | 1.3 | 5.87 | 1.94 | .57 | 8.38 | 6.00 | 7.81 | .... | 4.32 | 2.0* | 9.22 | 35.00 | 23.59 | 48.4 |
| **2052** | E. F. Coe's Fish Guano and Potash.............. | .... | .... | .... | 2.36 | 3.3 | 3.02 | 2.86 | 2.65 | 8.53 | .... | 5.88 | 6.0 | 3.60 | 4.0* | 6.40 | 35.00 | 22.03 | 58.9 |
| **2016** | Economical Bone Fertilizer. | .... | .18 | 1.83 | 2.01 | 1.3 | 3.13 | .66 | .82 | 4.61 | 6.00 | 3.79 | .... | 6.39 | 2.0* | 12.56 | 32.00 | 18.96 | 68.7 |
| **1996** | Wilkinson's Superphosphate | .. | .09 | 2.13 | 2.22 | 1.7 | 3.50 | .39 | .78 | 4.67 | .... | 3.89 | .... | 5.30 | 3.0 | 7.62 | 38.00 | 18.93 | 100.8 |

* As Sulphate.

## II. MANUFACTURERS' SAMPLES.

The analyses, tabulated on page 51, were made on samples deposited by manufacturers at the Station this year in accordance with the law, with a statement that they fairly represented the goods on sale in the State.

Their analysis is necessary because our agents did not find those brands in the stock which they inspected.

## III. SAMPLES DRAWN BY PRIVATE INDIVIDUALS.

**1949.** Chittenden's Ammoniated Bone Phosphate, made by National Fertilizer Co., Bridgeport. Sampled and sent by C. H. Cables, Thomaston.

**2040.** Adams' High Grade Ammoniated Bone, made by W. P. Adams, 248 Front St., New York. Sampled and sent by request of the Station by J. B. Linsley, selling agent, Fair Haven.

### ANALYSES AND VALUATIONS.

| | 1949. | | 2040. | |
|---|---|---|---|---|
| | Found. | Guaranteed. | Found. | Guaranteed. |
| Nitrogen in Nitrates | .67 | | ---- | |
| Nitrogen in Ammonia | .18 | | 1.06 | |
| Organic Nitrogen | 2.92 | 1.7 | 1.60 | |
| Total Nitrogen | 3.77 | | 2.66 | 2.5 |
| Soluble Phosphoric Acid | 4.41 | | 6.97 | 10.0 |
| Reverted Phosphoric Acid | 4.99 | | 1.56 | |
| Insoluble Phosphoric Acid | 4.76 | | .30 | |
| Total Phosphoric Acid | 14.16 | 9.0 | 8.83 | |
| Potash | 4.32 | 2.0 | 4.57 | 3.7 |
| Chlorine | 2.36 | | 1.58 | |
| Valuation per ton | $34.37 | | $27.48 | |
| Cost | 35.00 | | 38.00 | |

## SUPERPHOSPHATES FOR COMPARATIVE FIELD TEST.

Last spring the Station was asked to sample and analyze various fertilizers which had been sent to Shaker Station, for a comparison in the field, under arrangement with Mr. R. H. VanDeusen. The analyses are here given. The Station has no connection, other than this, with the tests which have been carried out.

**2087.** Church's Fish and Potash, from a lot of 1000 pounds.

**2083.** Economical Fertilizer, No. 3, made by Economical Fertilizer Co., Butler & Breed, selling agents. Stock of 800 pounds.

## NITROGENOUS SUPERPHOSPHATES.—MANUFACTURER'S SAMPLES.

| Station No. | Name or Brand. | Nitrogen as Nitrates. | Nitrogen as Ammonia. | Organic Nitrogen. | Total Nitrogen Found. | Total Nitrogen Guaranteed. | Phosphoric Acid. | | | | | | | Potash. | | Chlorine. | Valuation per Ton. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Soluble. | Reverted. | Insoluble. | Total Phosphoric Acid. | Phosphoric Acid Guaranteed. | Available. | | Found. | Guaranteed. | | |
| | | | | | | | | | | | | Found. | Guaranteed. | | | | |
| 2071 | Bradley's B. D. Sea Fowl Guano | .39 | .... | 2.32 | 2 71 | 2.5 | 7.24 | 2.58 | 2.71 | 12.53 | .... | 9.82 | 9.0 | 2.65 | 1.5 | 2.74 | $28.70 |
| 2072 | Bradley's Fish and Potash, Anchor Brand | .... | .... | 3.97 | 3.97 | 3.3 | 2.82 | 2.36 | 1.59 | 6.77 | .... | 5.18 | 3.0 | 3.88 | 3.0 | 8.85 | 26.20 |
| 2081 | Clark's Cove Guano Co's Great Planet B. Fertilizer | .... | 2.59 | 1.99 | 4.58 | 4.9 | 4.43 | 2.34 | .30 | 7.07 | .... | 6.77 | 5.0 | 7.73 | 7.0 | 1.48 | 34.83 |
| 2073 | Clark's Cove Guano Co's King Philip Alkaline Guano | .... | .23 | 1.32 | 1.55 | 1.2 | 5.28 | 1.96 | 3.17 | 10.41 | .... | 7.24 | 6.5 | 4.53 | 3.0 | 3.80 | 22.57 |
| 2070 | Common Sense Fertilizer No. 22 | .66 | 2.38 | 1.07 | 4.11 | 2.0 | .21 | 7.39 | 3.63 | 11.23 | 9.0 | 7.30 | .... | 1.78 | 1.0 | 1.75 | 29.30 |
| 2080 | Crocker's Fertilizer and Chemical Works' Queen City Phosphate | .... | .... | 1.64 | 1.64 | 1.7 | 5.53 | 3.47 | 2.12 | 11.12 | .... | 9.00 | 8.0 | 1.50 | 1.1 | 1.53 | 22.34 |
| 2041 | G. W. Miller's Flour of Bone Phosphate | .58 | .09 | 2.49 | 3.16 | .... | .43 | 7.92 | 3.75 | 12.10 | .... | 8.35 | .... | 5.33 | .... | 6.87 | 30.20 |
| 2076 | C. Prentice's Phosphate | .... | 1.20 | .92 | 2.12 | .... | 5.28 | 5.18 | 4.51 | 14.97 | .... | 10.46 | .... | 2.76 | .... | 2.72 | 28.70 |

**2085.** Mixture from F. Ellsworth, Hartford:
600 pounds Castor Pomace.
100 " Swift Sure Bone.
100 " Swift Sure Superphosphate.
145 " Muriate of Potash.
**2054.** Lister's Ammoniated Dissolved Bone.
**2036.** Mapes' Corn Manure.
**2086.** Sanderson's Formula A.
**2082.** Williams, Clark & Co's Americus Superphosphate.

### HOME-MIXED FERTILIZERS.

The *manufacture* of superphosphate on the farm from phosphatic materials and oil of vitriol is not commonly a paying operation.

The *mixing* of fertilizers on the farm, on the other hand, has proved itself in this and other States a very profitable undertaking in the hands of intelligent farmers who are able to pay cash for the raw materials and who purchase in ton lots or more, either singly or by clubbing together. It is stated by manufacturers that most agricultural chemicals can be bought nearly as cheaply in ton lots as in 100 ton lots, so that in the purchase of stock the one who manufactures on a small scale is at no very great disadvantage. Again, while the machinery of a fertilizer factory can undoubtedly mix a large lot of goods more cheaply than hand labor could do it, yet it does not follow that in all cases it costs more to mix on the farm.

It is safe to say that often the mixing of 2 or 3 tons of chemicals on the farm costs absolutely nothing because it is done at odd times by labor which is paid for but cannot be otherwise profitably employed during the winter and early spring. Again, there is greater security against inferior forms of nitrogen or phosphoric acid and their presence can be more easily detected in raw materials than in mixed goods.

Further, the purchaser saves more or less expense incident to the purchase of mixed goods, such as expenses of traveling and local agents, risks of the business and manufacturers' profits. Finally the intelligent farmer knows best what his land and special crops require and can suit these special needs by varying the composition of the mixture.

It is not claimed that everywhere and always home-mixtures are the most economical. It is often cheaper for the purchaser to buy the best commercial mixtures, ammoniated superphosphates

## FERTILIZERS FOR COMPARATIVE FIELD TEST.

| Station No. | Name or Brand. | Nitrogen as Nitrates. | Nitrogen as Ammonia. | Nitrogen Organic. | Total Nitrogen. | Phosphoric Acid. |  |  |  |  | Potash. |  |  | Chlorine. | Valuation per Ton. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  | Soluble. | Reverted. | Insoluble. | Total Phos. Acid. | Available Phos. Acid. | As Muriate. | As Sulphate. | Total Potash. |  |  |
| **2087** | Church's Fish and Potash | .... | .32 | 3.77 | 4.09 | 2.42 | 2.55 | .51 | 5.48 | 4.97 | 4.05 | .... | 4.05 | 6.20 | $25.76 |
| **2088** | Economical Fertilizer, No. 3 | trace | .... | .33 | .33 | .... | .17 | 6.11 | 6.28 | .17 | .24 | .... | .24 | 10.18 | 4.07 |
| **2085** | Mixed Fertilizer from F. Ellsworth, Hartford | .... | .... | 4.49 | 4.49 | 1.54 | 4.78 | .61 | 6.93 | 6.32 | 8.73 | ... | 8.73 | 6.62 | 33.13 |
| **2054** | Ammoniated Dissolved Bone Phosphate | .... | 1.04 | 1.17 | 2.21 | 10.60 | 1.36 | .83 | 12.79 | 11.96 | 1.35 | .19 | 1.54 | 1.02 | 28.60 |
| **2086** | Sanderson's Formula A | 1.45 | .09 | 2.56 | 4.10 | 7.79 | 1.91 | .31 | 10.01 | 9.70 | 7.87 | .... | 7.87 | 7.54 | 36.12 |
| **2082** | Americus Bone Superphosphate | .... | .78 | 1.89 | 2.67 | 8.90 | 2.03 | .37 | 11.30 | 10.93 | .47 | 2.10 | 2.57 | .36 | 29.57 |

and special manures, than to buy the chemicals and mix them, but the testimony of a yearly increasing number of farmers shows that often money may be saved by the seasonable purchase of raw materials and their use in home-mixtures. During the last year the Station has analyzed eleven home-mixed fertilizers and their analyses follow, together with details as to the materials employed. For table of analyses see page 57.

**1916.** Made by J. J. Webb, Hamden, from muriate of potash, sulphate of ammonia, dissolved bone black and tankage.

**1976.** Made by H. E. Bassett, Hamden, by the following formula:

| | | | | | | |
|---|---|---|---|---|---|---|
| 2000 | pounds | tankage | @ $26.00 | per ton, | costing | $26.00 |
| 1500 | " | dissolved bone black | @ 25.00 | " | " | 18.75 |
| 400 | " | muriate of potash | @ 40.00 | " | " | 8.00 |
| 400 | " | sulphate of potash | @ 30.00 | " | " | 6.00 |
| 4300 | " | | | | | $58.75 |

Cost of ingredients per ton, $27.32. No estimate given of cost of mixing. Mr. Bassett bought in New Haven at current rates and had no freight charges additional to what he would have had for commercial fertilizers.

**1980.** Made by C. T. Merwin, Milford, by the following formula:

| | | | | | | |
|---|---|---|---|---|---|---|
| 2500 | pounds | dissolved bone black | @ $23.00 | per ton, | costing | $28.75 |
| 1000 | " | muriate of potash | @ 39.00 | " | " | 19.50 |
| 2000 | " | fish scrap | @ 35.00 | " | " | 35.00 |
| 500 | " | sulphate of ammonia | @ 67.50 | " | " | 16.88 |
| 6000 | | | | | | $100.13 |
| | | To which add freight | | | | 4.00 |
| | | Cost of mixing | | | | 3.00 |
| | | | | | | $107.13 |

Cost of fertilizer, mixed, $35.71 per ton.

Mr. Merwin bought his dissolved bone black, muriate of potash and sulphate of ammonia below the usual retail market rate.

**1981.** Made by C. T. Merwin, Milford, by the following formula:

| | | | | | | |
|---|---|---|---|---|---|---|
| 2500 | pounds | dissolved bone black | @ $23.00 | per ton, | costing | $28.75 |
| 1000 | " | muriate of potash | @ 39.00 | " | " | 19.50 |
| 2000 | " | tankage | @ 25.00 | " | " | 25.00 |
| 500 | " | sulphate of ammonia | @ 67.50 | " | " | 16.88 |
| 6000 | | | | | | $90.13 |
| | | To which add freight | | | | 4.00 |
| | | Cost of mixing | | | | 3.00 |
| | | | | | | $97.13 |

Cost of fertilizer, mixed, $32.37.

As in the last case Mr. Merwin got his dissolved bone black, muriate of potash and sulphate of ammonia below the usual market rate.

**1983.** Made by J. C. Eddy, Simsbury, according to the following formula:

| | | | | | | |
|---|---|---|---|---|---|---|
| 4000 | pounds | animal dust............@ | $27.00 | per ton, | costing | $54.00 |
| 1635 | " | dissolved bone black....@ | 25.00 | " | " | 20.44 |
| 800 | " | sulphate of potash......@ | 30.00 | " | " | 12.00 |
| 565 | " | muriate of potash.......@ | 40.00 | " | " | 11.30 |
| 7000 | | | | | | $97.74 |
| | | To which add freight to Simsbury.............. | | | | 10.34 |
| | | Cost of mixing.............................. | | | | 3.00 |
| | | | | | | $111.08 |

Cost of the mixed fertilizer, $31.75 per ton.

The goods shrunk 50 pounds in mixing from drying out and mechanical loss.

**2089.** Potato Fertilizer. Made by C. S. Phelps at farm of C. M. Beach, West Hartford, by the following formula:

| | | | | | | |
|---|---|---|---|---|---|---|
| 500 | pounds | double manure salt......@ | $22.50 | per ton, | costing | $ 5.63 |
| 100 | " | muriate of potash.......@ | 37.00 | " | " | 1.85 |
| 300 | " | dried blood.............@ | 34.40 | " | " | 5.16 |
| 500 | " | nitrate of soda...........@ | 47.20 | " | " | 11.80 |
| 600 | " | dissolved So. Carolina rock,@ | 16.40 | " | " | 4.90 |
| 2000 | | | | | | $29.34 |
| | | To which add for freight and cartage............. | | | | 1.80 |
| | | Cost of mixing.............................. | | | | 1.50 |
| | | | | | | $32.64 |

Cost of the mixed fertilizer, $32.64 per ton.

The double manure salt, muriate of potash and nitrate of soda used in this and the next following fertilizer were purchased in New York, the other materials in Hartford.

**2090.** Corn Fertilizer. Made by C. S. Phelps at the farm of C. M. Beach, West Hartford, by the following formula:

| | | | | | | |
|---|---|---|---|---|---|---|
| 1000 | pounds | dissolved So. Carolina rock,@ | $16.40 | per ton, | costing | $ 8.20 |
| 150 | " | dissolved bone black....@ | 24.00 | " | " | 1.80 |
| 200 | " | dried blood.............@ | 34.40 | " | " | 3.44 |
| 350 | " | nitrate of soda...........@ | 47.20 | " | " | 8.26 |
| 300 | " | muriate of potash.......@ | 37.00 | " | " | 5.55 |
| 2000 | | | | | | $27.25 |
| | | To which add for freight and cartage............. | | | | 1.10 |
| | | Cost of mixing.............................. | | | | 1.50 |
| | | | | | | $29.85 |

Cost of the mixed fertilizer, $29.85 per ton.

**2094.** Made by N. S. Platt, Cheshire, from the following formula:

500 pounds tankage.
700 " sulphate of potash.
800 " dissolved bone black.

Mr. Platt purchased the materials somewhat under the usual market rate, so that they cost him $27.20 per ton in Cheshire *unmixed.*

**2096.** Made by Lyman H. Francis, Meriden, by the following formula:

400 pounds muriate of potash.
400 " dissolved bone black.
400 " tankage.
800 " nitrate of soda.

At the regular market rates the cost would have been $43.30, unmixed. Mr. Francis purchased for $38.00.

**2097.** Made by N. S. Baldwin, Meriden, by the following formula:

400 pounds nitrate of soda.
800 " kainit.
800 " tankage.

At regular market rates the cost would have been $30.80. Mr. Baldwin states that he purchased for $20.50.

**2151.** Made by George F. Platt, Milford, by the following formula:

| | | | | | | |
|---|---|---|---|---|---|---|
| 500 | pounds | sulphate of ammonia....@ | $72.48 | per ton, | costing | $18.12 |
| 3000 | " | bone, blood and meat....@ | 25.00 | " | " | 37.50 |
| 2000 | " | dissolved bone black.....@ | 31.00 | " | " | 31.00 |
| 2000 | " | ground bone .....@ | 35.00 | " | " | 35.00 |
| 1000 | " | muriate of potash.......@ | 43.50. | " | " | 21.75 |
| 1000 | " | sulphate of potash ......@ | 37.00 | " | " | 18.50 |
| 9500 | | | | | | $161.87 |

The prices do not include freight, but Mr. Platt by paying cash got such discounts from dealers' rates as made the goods cost $161.53 delivered in Milford. The cost of mixing was $4.72, so that the entire cost of 4¾ tons was $166.25 or $35.00 per ton.

In almost all cases the Station has analyzed the raw materials of which the mixture was made, so that it is possible to calculate the composition of the mixture, supposing all the goods to have been uniform in quality, the weights correct and the mixture uni-

## HOME MIXED FERTILIZERS.

| | 1916 | | 1976 | | 1980 | | 1981 | | 1983 | | 2089 | | 2090 | | 2094 | | 2096 | | 2097 | | 2151 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Found. | Calculated. | Found. | Calculated. | Found. | Calculated. | Found. | Calculated. | Found. | Calculated. | Found. | Calculated. | Found. | Calculated. | Found. | Calculated. | Found. | Calculated. | Found. | Calculated. | Found. | Calculated. |
| Nitrogen as Nitrates | | | | | | | | | | | 3.93 | | 2.85 | | | | 7.36 | | .77 | | | |
| Nitrogen as Ammonia | 1.89 | | | | 1.85 | | 2.08 | | | | | | | | | | | | | | .98 | |
| Nitrogen (organic) | 2.70 | | 4.35 | | 2.45 | | 2.92 | | 3.49 | | 1.38 | | 1.03 | | 1.93 | | | | 3.63 | | 3.57 | |
| Total Nitrogen | 4.59 | | 4.35 | 4.19 | 4.30 | 4.35 | 5.00 | 4.43 | 3.49 | 3.35 | 5.31 | 5.30 | 3.88 | 3.7 | 1.93 | 1.87 | 7.36 | 7.68 | 4.40 | 5.76 | 4.55 | 4.39 |
| Soluble Phosphoric Acid | 5.79 | | 5.61 | | 6.40 | | 6.39 | | 3.84 | | 3.98 | | 6.96 | | 5.92 | | 3.12 | | | | 3.09 | |
| Reverted Phosphoric Acid | 2.46 | | 1.31 | | 2.19 | | 1.93 | | 4.85 | | .71 | | 1.43 | | 2.86 | | 2.70 | | 4.63 | | 5.37 | |
| Insoluble Phosphoric Acid | .93 | | .43 | | .31 | | .44 | | 1.75 | | .22 | | .48 | | 1.01 | | .45 | | 1.89 | | 2.70 | |
| Total Phosphoric Acid | 9.18 | | 7.35 | 7.74 | 8.90 | 8.69 | 8.76 | 8.84 | 10.44 | 10.43 | 4.91 | 4.60 | 8.87 | 9.0 | 9.79 | 9.42 | 6.27 | 6.34 | 6.52 | 6.33 | 11.16 | 9.43 |
| Potash as Muriate | 7.97 | | 6.02 | | 10.20 | | 10.69 | | 4.56 | | 4.18 | | 8.14 | | 1.39 | | 9.28 | | 5.95 | | 7.40 | |
| Potash as Sulphate | | | 1.62 | | | | | | 3.44 | | 5.51 | | | | 8.16 | | | | | | | |
| Total Potash | 7.97 | | 7.64 | 7.26 | 10.20 | 8.48 | 10.69 | 8.63 | 8.00 | 7.21 | 9.69 | 9.00 | 8.14 | 7.5 | 9.55 | 9.50 | 9.28 | 10.17 | 5.95 | 4.91 | 7.40 | 8.08 |
| Chlorine | | | 4.54 | | | | | | | | 3.15 | | | | 1.05 | | 8.04 | | 12.66 | | 5.00 | |
| Valuation per ton | $36.35 | | $33.33 | | $37.44 | | $39.96 | | $34.34 | | $34.59 | | $33.23 | | $31.29 | | $40.75 | | $28.30 | | $36.83 | |
| Cost per ton | | | 27.32* | | 35.71 | | 32.37 | | 31.75 | | 32.64 | | 29.80 | | 27.20* | | 38.00* | | | | 35.00 | |

* Actual cost of ingredients unmixed.

form. It appears that there is in all but three cases a very satisfactory agreement between the actual and calculated quantities of nitrogen and phosphoric acid present, while the actual quantity of potash present is in all but one case larger than the calculated quantity. The discrepancies are greatest in Nos. **1981** and **2097.**

If the valuation of **1981** was based on the calculated rather than the actual composition of the sample it would be $36.23 instead of $39.96. If the valuation of **2097** were based on its calculated composition it would be a little over $30.00 and that of **2156** $34.57. In all but one case, however, valuation even if based on the calculated composition, is still not less than the cost.

The mechanical condition of the samples sent was certainly as good as that of the average commercial mixtures, hence it is fair to conclude that those who made these mixtures instead of buying commercial mixtures of average composition saved some 20–25 per cent. of their outlay, since the average retail cash price of nitrogenous superphosphates is from 20–25 per cent. higher than their valuation. In order to buy to the best advantage cash payment and orders for some considerable quantity of material are necessary. For the information of those interested is here appended a form taken with slight alterations from a circular sent to dealers in fertilizer chemicals by the Moorestown Grange in New Jersey, and which may be convenient for the use of granges and farmers' clubs in this State.

"Wanted: to buy the materials to make ——— tons *or more* of fertilizer. The materials to consist of nitrate of soda, sulphate of ammonia, acid phosphate, dissolved bone or bone black, fine ground bone, fine ground fish scrap, muriate of potash and sulphate of potash.

All materials to be in good mechanical condition; in good bags; to run even weights or be plainly marked what each bag contains *net*, and to be delivered at ——— early in March next. All materials to be guaranteed to contain certain percentages of nitrogen, potash, or available phosphoric acid, as the case may be; one-half the bill to be paid within ten days after receipt of goods; on the other half a credit of sixty days to be allowed, within which time samples will be sent to the Connecticut Experiment Station for analysis, and if there found to contain as large percentages as guaranteed the balance of bill will be paid within the sixty days, but if any are found to contain a *less* percentage than guaranteed, then a discount is to be allowed on the bill equal to the loss in money value caused by such deficiency for the first one per cent. or fraction thereof, and *twice* the loss in money value for all deficiencies in excess of one per cent., and balance of bill within the sixty days. Samples to be taken by a station agent or other disinterested party."

## SPECIAL MANURES.

### I. *Sampled by Station Agents.*

The tables on pages 61 to 65, contain twenty analyses of this class, which were made on samples known to fairly represent the stock from which they were taken. Of some, several samples were secured, and the analysis was made on a mixture of them as already explained on page 33.

The retail cash price of Fairchild's Formula for Corn and Wheat, No. **2068**, was reduced August 1, from $46 to $44 per ton.

In April an analysis was made on a mixture of three samples of Baker's Special Potato Fertilizer. Objection was made to this analysis by the manufacturer, on the ground that it did not fairly represent the quality of this brand. This analysis is numbered **1937** in the table on page 60. To show whether this analysis was or was not fairly representative, the Station took the trouble to analyze separately every sample of this one brand which we had collected. The analyses are given in the table, page 60. Finally the five separate analyses were averaged to give the figures printed in the table on page 65—No. **2126**.

These analyses show that the first analysis made on a mixture did fairly represent the brand, they show the general uniformity in the goods, and also furnish an illustration of the desirability of analyzing mixtures of samples instead of depending on a single sample. For while an analysis of either of four samples would have given a correct statement of the character of the goods, an analysis of the fifth alone would have given a showing less correct and more favorable.

*Cost and Valuation.*—The average cost of the special manures sampled by the Station has been $42.52, and the average valuation $35.20. The difference, $7.32, makes the percentage difference 20.9. The corresponding difference in case of the superphosphates was 25.6. This year, as heretofore, the special manures as a class have been higher priced but more concentrated than the other nitrogenous superphosphates, and if the quality of the raw materials composing them is equally good, they have been the more economical to purchase.

## BAKER'S POTATO FERTILIZER.

| | A Mixture of the three following samples. | Stock of R. B. Bradley & Co. | Stock of C. O. Jeliff & Co., March 22. | Stock of Dennis Fenn. | Stock of Allen Betts. | C. O. Jeliff & Co. May 19. | Average of the five preceding. |
|---|---|---|---|---|---|---|---|
| | **1987** | **1989** | **1990** | **1991** | **1992** | **2063** | **2126** |
| Nitrogen as Ammonia | 3.14 | 3.05 | 3.24 | 3.01 | 3.24 | 3.70 | 3.25 |
| Organic Nitrogen | .59 | .42 | .54 | .65 | .61 | .58 | .56 |
| Total Nitrogen | 3.73 | 3.47 | 3.78 | 3.66 | 3.85 | 4.28 | 3.81 |
| Soluble Phosphoric Acid | 5.87 | 5.76 | 5.90 | 6.56 | 6.68 | 5.71 | 6.12 |
| Reverted Phosphoric Acid | .58 | .48 | .85 | .27 | .26 | .87 | .55 |
| Insoluble Phosphoric Acid | .21 | .25 | .27 | .06 | .10 | .20 | .18 |
| Total Phosphoric Acid | 6.66 | 6.49 | 7.02 | 6.89 | 7.04 | 6.78 | 6.84 |
| Potash | 10.24 | 10.20 | 9.81 | 10.57 | 9.13 | 10.17 | 9.98 |
| Chlorine | 4.24 | 3.32 | 3.96 | 5.54 | 5.54 | 6.43 | 4.96 |
| Valuation per ton | $33.31 | 32.55 | 33.58 | 33.55 | 33.65 | 34.60 | 33.39 |

## SPECIAL MANURES SAMPLED BY THE STATION.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| 2068 | Fairchild's Corn Formula. | The Rogers & Hubbard Co., Middletown, Conn. | Strong & Backus, Colchester. | $46.00 | $46.00 |
| 2030 | Complete Manure for Potatoes and Vegetables. | Bradley Fertilizer Co., 27 Kilby St., Boston, Mass. | E. S. Gillette, Easton. | .... | 42.00 |
| | | | J. A. Lewis, Willimantic. | 42.00 | |
| | | | Chas. Jennings & Son, Southport. | 43.00 | |
| | | | J. W. Beach, Stratford. | 45.00 | |
| 2050 | Complete Manure for Corn and Grain. | Bradley Fertilizer Co., 27 Kilby St., Boston, Mass. | S. Stevens, Glastonbury. | 42.00 | 42.00 |
| 1936 | Quinnipiac Potato Manure. | Quinnipiac Co., New London, Conn. | E. A. Godfrey, Southport. | 38.00 | 38.00 |
| 2056 | Tobacco Manure for Use with Stems. | Mapes' Formula & Peruvian Guano Co., 158 Front St., New York. | Mapes' Branch, Hartford. | 46.00 | 46.00 |
| 2057 | Grass and Grain Spring Top Dressing. | Mapes' Formula and Peruvian Guano Co., 158 Front St., New York. | Birdsey & Foster, Meriden. | 44.50 | 43.00 |
| | | | Dean & Horton, Stamford. | 44.00 | |
| 2027 | Stockbridge Forage Crop Manure. | Bowker Fertilizer Co., 43 Chatham St., Boston, Mass. | Brewster & Burnett, Norwich. | 42.50 | 40.00 |
| | | | R. S. Converse, Stafford. | 42.00 | |
| | | | Southington Lumber and Feed Co., Southington. | 41.50 | |
| 1930 | Mapes' Potato Manure. | Mapes' Formula & Peruvian Guano Co., 158 Front St., New York. | R. B. Bradley & Co., New Haven. | 45.00 | 45.00 |
| | | | Mapes' Branch, Hartford. | 45.00 | |
| | | | W. W. Cooper, Suffield. | 43.00 | |
| 2051 | Bradley's Complete Top Dressing for Grass and Grain. | Bradley Fertilizer Co., 27 Kilby St., Boston, Mass. | Burtis & Mead, New Canaan. | 42.00 | 42.00 |
| 1993 | Stockbridge Potato and Vegetable Manure. | Bowker Fertilizer Co., 43 Chatham St., Boston, Mass. | T. Pease & Sons Co., Windsor Locks. | 43.00 | 40.00 |
| | | | H. K. Brainard, Thompsonville. | 40.00 | |
| 2055 | Mapes' Tobacco Manure (Conn. Brand). | Mapes' Formula & Peruvian Guano Co., 158 Front St., New York. | W. W. Cooper, Suffield. | 46.00 | 46.00 |

## SPECIAL MANURES SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| 2036 | Mapes' Corn Manure. | Mapes' Formula & Peruvian Guano Co., 158 Front St., New York. | R. H. Van Deusen, Shaker Station. | $44.00 | $13.00 |
| | | | J. P. Barstow, Norwich. | 43.00 | |
| | | | J. O. Fox & Co., Putnam. | 46.00 | |
| | | | Southington Lumber and Feed Co., Southington. | 43.00 | |
| | | | Dunham & Co., Cheshire. | 45.00 | |
| | | | Wilson & Burr, Middletown. | 43.00 | |
| | | | W. W. Cooper, Suffield. | 43.00 | |
| 2063 | Baker's Special Potato Manure. | H. J. Baker & Bro., 215 Pearl St., New York. | C. O. Jelliff & Co., Southport. | 43.00 | 45.00 |
| 1964 | Bradley's Potato Manure. | Bradley Fertilizer Co., 27 Kilby St., Boston, Mass. | J. W. Beach, Stratford. | 38.00 | 38.00 |
| | | | Mather & Gruman, Darien. | 38.00 | |
| | | | Burtis & Mead, New Canaan. | 40.00 | |
| | | | Chas. Jennings, Southport. | 38.00 | |
| | | | A. A. Hubbard, Canaan. | 38.00 | |
| 2035 | Lister's Potato Manure. | Lister Agricultural and Chemical Works, Newark, N. J. | C. Swan, State St., Bridgeport. | 45.00 | ---- |
| | | | A. N. Clark, Milford. | 40.00 | |
| 2049 | Tobacco and Onion Manure. | Williams & Clark Co., Hanover Square, New York. | N. H. Smith & Co., Norwalk. | 44.00 | 42.00 |
| | | | E. M. Jennings, Southport. | 42.00 | |
| 1973 | Americus Special Fertilizer for Potatoes. | Williams, Clark & Co., New York. | D. B. Wilson & Co., Waterbury. | 42.00 | 42.00 |
| | | | E. M. Jennings, Southport. | 42.00 | |
| | | | J. Goodman, E. Litchfield. | 41.50 | |
| | | | Atwood & Wilson, Watertown. | 45.00 | |

## SPECIAL MANURES SAMPLED BY THE STATION—*Continued.*

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Dealer's cash price per ton. | Manufacturer's statement of average cash price per ton. |
|---|---|---|---|---|---|
| **2001** | Stockbridge Grain Manure. | Bowker Fertilizer Co., 43 Chatham St., Boston, Mass. | Hubbell & Bradley, Saugatuck. | $43.00 | $40.00 |
| | | | T. Pease & Sons Co., Windsor Locks. | 43.00 | |
| | | | Dunham & Co., Cheshire. | 45.00 | |
| | | | Southington Lumber and Feed Co., Southington. | 41.50 | |
| **2002** | Potato, Hop and Tobacco Phosphate. | Crocker Fertilizer and Chemical Co., Buffalo, N. Y. | J. S. Bragg, Canaan. | 37.00 | .... |
| | | | J. H. Reay, Greenwich. | 38.00 | |
| | | | E. T. Morehouse, New Hartford. | 40.00 | |
| | | | J. M. Belden, New Britain. | 40.00 | |
| **2126** | Special Potato Manure. | H. J. Baker & Bro., 215 Pearl St., New York. | C. O. Jeliff & Co., Southport. | 45.00 | 45.00 |
| | | | Dennis Fenn, Milford. | 45.00 | |
| | | | R. B. Bradley & Co., New Haven. | 45.00 | |
| | | | C. O. Jeliff & Co., Southport. | 43.00 | |
| | | | Allen Betts, Norwalk. | 44.00 | |
| **2064** | Baker's Complete Corn Manure. | H. J. Baker & Bro., 215 Pearl St., New York. | C. O. Jeliff & Co., Southport. | 45.00 | 45.00 |
| | | | R. B. Bradley & Co., New Haven. | .... | |

## ANALYSES OF SPECIAL MANURES SAMPLED BY THE STATION.

| Station No. | Name or Brand. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | Chlorine. | Cost per Ton. | Valuation per Ton. | Percentage Difference between Cost and Valuation. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nitrogen as Nitrates. | Nitrogen as Ammonia. | Organic Nitrogen. | Total Nitrogen found. | Nitrogen Guaranteed. | Soluble. | Reverted. | Insoluble. | Total Found. | Total Guaranteed. | Available. | | Found. | Guaranteed. | | | | |
| | | | | | | | | | | | | Found. | Guaranteed. | | | | | | |
| **2068** | Fairchild's Corn Formula.. | 3.81 | .... | 1.90 | 5.71 | .... | .... | .... | .... | 13.71 | .... | .... | .... | 13.28§ | .... | .... | $46.00 | $45.49 | 1.1 |
| **2030** | Bradley's Complete Manure for Potatoes and Veg'bles | .62 | 1.06 | 2.31 | 3.99 | 3.8 | 9.31 | 1.89 | .54 | 11.74 | .... | 11.20 | 8.0 | 6.08 | 6.0 | .98 | 42.00 | 38.20 | 9.9 |
| **2050** | Bradley's Complete Manure for Corn and Grain ..... | .79 | .51 | 3.26 | 4.56 | 3.7 | 8.02 | 1.57 | .69 | 10.28 | 10.0 | 9.59 | 9.0 | 7.14 | 5.5 | 4.72 | 42.00 | 37.62 | 11.6 |
| **1936** | Quinnipiac Potato Manure. | .52 | .69 | 2.91 | 4.12 | 3.3 | 3.42 | 4.08 | 2.20 | 9.70 | .... | 7.50 | 5.0 | 6.36 | 6.0 | .93 | 38.00 | 33.87 | 12.2 |
| **2056** | Mapes' Tobacco Manure for Use with Stems ........ | .66 | 2.41 | 2.43 | 5.50 | 5.4 | 7.82 | 2.95 | 1.45 | 12.22 | 10.5 | 10.77 | .... | 3.86 | 3.5 | .37 | 46.00 | 40.99 | 12.2 |
| **2057** | Mapes' Grass and Grain Top Dressing .............. | .83 | 1.87 | 1.94 | 4.64 | 4.1 | 5.97 | 4.66 | 1.68 | 12.31 | 7.0 | 10.63 | .... | 6.50 | 5.0 | 5.91 | 44.00‡ | 39.07 | 12.6 |
| **2027** | Stockbridge Forage Crop.. | .51 | 2.36 | 2.79 | 5.66 | 5.5 | 5.86 | 1.41 | 1.78 | 9.05 | 6.0 | 7.27 | 5.0 | 2.85 | 2.5 | 1.58 | 41.50 | 34.84 | 19.1 |
| **1930** | Mapes' Potato Manure..... | 1.61 | 1.55 | .69 | 3.85 | 3.7 | 4.89 | 4.50 | 3.68 | 13.07 | 8.0 | 9.39 | .... | 7.50 | 6.0* | .66 | 45.00 | 37.80 | 19.1 |
| **2051** | Bradley's Complete Top Dressing for Grass and Grain ................ | 4.15 | .... | .38 | 4.53 | 4.1 | 4.99 | 2.96 | 2.98 | 10.93 | 7.0 | 7.95 | 6.0 | 5.62 | 5.0 | trace | 42.00 | 35.00 | 20.0 |
| **1993** | Stockbridge Potato and Vegetable Manure.......... | .... | 2.45 | 1.03 | 3.48 | 3.3 | 6.93 | 2.72 | 1.64 | 11.29 | .... | 9.65 | 8.0 | 5.68 | 7.0 | 6.38 | 40.00 | 33.15 | 20.7 |
| **2055** | Mapes' Tobacco Manure [Conn. Brand].......... | .54 | 2.69 | 1.42 | 4.65 | 4.7 | 6.97 | 1.20 | .24 | 8.41 | 7.8 | 8.17 | .... | 7.53 | 7.8 | .44 | 46.00 | 37.34 | 23.2 |
| **2036** | Mapes' Corn Manure...... | 1.14 | 1.29 | 1.51 | 3.94 | 3.7 | 5.37 | 3.97 | 3.08 | 12.42 | 10.0 | 9.34 | .... | 6.77 | 6.0 | 6.26 | 43.00 | 35.60 | 23.6 |
| **1964** | Bradley's Potato Manure... | .42 | .... | 2.68 | 3.10 | 2.7 | 6·04 | 1.71 | 2.22 | 9.97 | 8.0 | 7.75 | 6.0 | 6.16 | 6.0 | 3.76 | 38.00 | 29.81 | 27.5 |
| **2035** | Lister's Potato Manure.... | .61 | 1.85 | 1.66 | 4.12 | 3.7 | 8·22 | .41 | .12 | 8.75 | .... | 8.63 | 8.5 | 5.90 | 7.0 | 4.42 | 42.50 | 33.12 | 28.3 |

* As Sulphate.

§ As Muriate.

‡ Manufacturer quotes $43 which would make the percentage difference 10.0.

## ANALYSES OF SPECIAL MANURES SAMPLED BY THE STATION—*Concluded.*

| Station No. | Name or Brand. | Nitrogen. | | | | | Phosphoric Acid. | | | | | | | Potash. | | Chlorine. | Cost per Ton. | Valuation per Ton. | Percentage Difference between Cost and Valuation. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Nitrogen as Nitrates. | Nitrogen as Ammonia. | Organic Nitrogen. | Total Nitrogen found. | Nitrogen Guaranteed. | Soluble. | Reverted. | Insoluble. | Total Found. | Total Guaranteed. | Available. | | Found. | Guaranteed. | | | | |
| | | | | | | | | | | | | Found. | Guaranteed. | | | | | | |
| **2049** | Williams, Clark & Co.'s Tobacco and Onion Manure. | .... | 1.75 | 2.88 | 4.63 | 4.0 | 3.93 | 1.22 | .65 | 5.80 | 5.0 | 5.15 | .... | 7.19 | 8.0 | .54 | $42.00 | $32.45 | 29.4 |
| **1973** | Americus Special for Potatoes | .... | 2.04 | 1.36 | 3.40 | 3.3 | 5.60 | 1.44 | .33 | 7.37 | 7.0 | 7.04 | .... | 8.10 | 8.0 | trace | 42.00 | 32.13 | 30.7 |
| **2001** | Stockbridge Grain Manure | .... | 1.39 | 1.88 | 3.27 | 3.3 | 7.89 | 2.10 | 1.77 | 11.76 | 7.0 | 9.99 | 6.0 | 3.95 | 4.0 | 4.32 | 41.50† | 31.63 | 31.2 |
| **2002** | Potato, Hop and Tobacco Phosphate | .... | trace | 2.47 | 2.47 | 2.0 | 8.21 | 2.44 | .66 | 11.31 | .... | 10.65 | 8.0 | 3.96 | 3.5 | 3.64 | 39.00 | 29.22 | 33.4 |
| **2126** | Baker's Special Potato Manure | .... | 3.25 | .56 | 3.81 | 3.3 | 6.12 | .55 | .18 | 6.84 | .... | 6.67 | 5.8 | 9.98 | 10.0 | 4.96 | 45.00 | 33.39 | 34.7 |
| **2064** | Baker's Complete Corn Manure | .... | 3.58 | .74 | 4.32 | 5.0 | 6.57 | .46 | .16 | 7.19 | .... | 7.03 | 6.3 | 8.08 | 7.0 | 11.03 | 45.00 | 33.29 | 35.2 |

† Manufacturer quotes $40 which would make the percentage difference 26.4.

## II. *Manufacturer's Sample.*

### PRENTICE'S POTATO PHOSPHATE.

**2077.** This is the only manufacturer's sample of a special fertilizer analyzed this year. Analyses of all other special fertilizers sold in the State have been made on samples collected by agents of the Station.

| | 2077. |
|---|---|
| Nitrogen as Ammonia | 2.22 |
| Organic Nitrogen | .67 |
| Soluble Phosphoric Acid | 6.35 |
| Reverted Phosphoric Acid | 2.18 |
| Insoluble Phosphoric Acid | 3.05 |
| Potash | 8.78 |
| Chlorine | 8.46 |
| Valuation per ton | $32.84 |

## III. *Sampled by Private Individuals.*

### PEACH YELLOWS CURE.

**2093.** Made by H. J. Baker & Bro., New York. Sampled and sent by N. S. Platt, from stock of C. S. Gillette, Cheshire.

| | |
|---|---|
| Nitrogen | .37 |
| Soluble Phosphoric Acid | 9.92 |
| Reverted Phosphoric Acid | 1.18 |
| Insoluble Phosphoric Acid | none. |
| Potash | 11.68 |
| Chlorine | 11.16 |
| Cost per ton | $38.00 |

### BONE MANURES.

The terms "Bone Dust," "Ground Bone," "Bone Meal" and "Bone" applied to fertilizers, may in some cases, signify material made from dry, clean and pure bones such as shank bones used in making knife handles; in other cases these terms refer to the result of crushing fresh or moist bones which have been thrown out either raw or after cooking, with more or less meat, tendon and grease—and if taken from garbage or ash heaps, with ashes or soil adhering; again they denote mixtures of bone, blood, meat and other slaughter-house refuse which have been cooked in steam-tanks in order to recover grease, and are then dried and sold as "tankage;" or, finally, they apply to bone from which a large share of the nitrogenous substance has been extracted in the glue manufacture. The nitrogen of all these varieties of bone when they are in the same state of mechanical subdivision has essentially the same fertilizing value.

### I. *Sampled by the Station.*

On pages 69–71 will be found 19 analyses of bone manures made on samples collected by agents of the Station.

Of these the following appear to be strictly pure ground raw bone:

**1903,** **1905** and **2136,** H. J. Baker's Strictly Pure Bone; and **2061**, made by the Rogers & Hubbard Co.; and **2060,** made by the Crocker Fertilizer Co.

The following are tolerably clean cooked bone: **1904** and **2133,** Quinnipiac Co.'s; **1907,** Darling's; **1933,** Meyer's; **1958,** Chittenden's; **1961,** Bradley's, and **2125,** Armour's. **1967** is bone from which the nitrogen has been largely extracted in the process of glue manufacture. Sanderson's Bone, **1894** and **2120** is apparently a mixture of bone and tankage. Lister's Bone, **1934,** and Coe's Bone, **1906** and **2004,** are mixtures of tankage, bone and salts.

In Bulletin No. 91, issued in April last, it was stated that Swift Sure Bone, **1908,** and Americus Pure Bone, **1927,** were mixtures of bone and tankage. An inspection of the samples and the fact that they contain a larger percentage of nitrogen than other grades of pure bone usually contain,—6.57 and 4.44 per cent.—while the per cent. of phosphoric acid is rather low for a pure bone—19.44 and 18.24—led us to this conclusion. The manufacturers have since informed us that the goods are not mixtures of bone and tankage.

The Swift Sure Bone is stated to consist of bone from which all adhering meat is removed and which is dried and deprived of all grease by a process which leaves the material dry, brittle and very porous. The Americus Pure Bone is stated to be made from green butcher's bones which are put in steam-tight tanks and subjected to pressure which removes the grease. The entire product remaining in the tank is dried and ground.

The system of valuation of bone, which depends on the mechanical condition of the sample as well as on its chemical analysis, has already been explained on page 29.

Leaving out of account the two samples of E. F. Coe's bone, **1906** and **2004,** and Lister's bone, **1934,** which contain a considerable quantity of alkaline salts, the average cost per ton of the fifteen samples, whose cost and valuation are both given, is $35.00, and the average valuation is $40.41. Since bone is a raw material and not a mixed fertilizer its valuation should agree pretty closely with its average market price.

The figures indicate that the Station schedule of valuations is too high as far as it applies to bone manures.

There are three analyses of H. J. Baker's Bone in the table. Two were made in the spring, and the third, **2136**, in the fall, from a stock of 70 tons. Competition being at this time and place very active, the price was cut to $32.00, the regular price being $35.00. A second analysis of Quinnipiac Bone, **2133**, was made from stock sampled last spring, at the request of the manufacturers who believed the first analysis, **1904**, did not fairly represent the quality of the goods.

### II. *Sampled by manufacturers and private individuals.*

On page 72 are four analyses of samples of bone furnished by manufacturers in compliance with the terms of the fertilizer law.

### PECK'S PURE GROUND BONE.

**2114**. Made by Peck Brothers, Northfield. Sampled by Apothecaries Hall Co., Waterbury, from their stock.

MECHANICAL ANALYSIS.

| | | | |
|---|---|---|---|
| Fine, smaller than | 1/50 | inch | 10 |
| Fine medium, smaller than | 1/25 | " | 15 |
| Medium, smaller than | 1/12 | " | 38 |
| Coarse medium, smaller than | 1/6 | " | 35 |
| Coarse, larger than | 1/6 | " | 2 |
| | | | 100 |

ANALYSIS AND VALUATION.

| | |
|---|---|
| Nitrogen | 4.41 |
| Phosphoric acid | 21.62 |
| Cost per ton | $32.00* |
| Valuation per ton | $31.95 |

* Cash at mill.

In bulletin No. 88, July, 1886, the price of Peck Brothers' Pure Bone at the dealer's store was given as $35.00, and in a foot note, the price at mill was given, $33.00. In the annual report for 1886 the quotation *at mill* was omitted by an oversight.

### BONE MANURES.—SAMPLED BY STATION.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Cost Per Ton. |
|---|---|---|---|---|
| **1967** | Peter Cooper's Pure Bone Dust. | Peter Cooper's Glue Factory, 16 Burling Slip, New York City. | W. B. Meeker, Southport.<br>Wilson & Burr, Middletown. | $28.00<br>28 00 |
| **2136** | Baker's Strictly Pure Ground Bone. | H. J. Baker & Bro., 215 Pearl St., New York City. | C. O. Jelliff & Co., Southport. | 32.00 |
| **2125** | Armour's Bone. | Armour Glue Works, 205 La Salle St., Chicago, Ill. | R. A. Moore, Berlin. | 32.00 |
| **1903** | Baker's Strictly Pure Ground Bone. | H. J. Baker & Bro., 215 Pearl St., New York City. | C. O. Jelliff & Co., Southport. | 35.00 |
| **2133** | Quinnipiac Bone Meal. | Quinnipiac Co., New London, Conn. | R. B. Bradley & Co., New Haven. | |
| | | | W. F. Benedict, Stepney Depot. | 36.00 |
| | | | Olds & Whipple, Hartford. | 37.00 |
| | | | Chandler & Morse, Putnam. | 34.00 |
| | | | E. A. Godfrey, Westport. | 34.00 |
| **1961** | Bradley's Fine Bone. | Bradley Fertilizer Co., 27 Kilby St., Boston, Mass. | Chas. Jennings & Son, Southport. | 35.00 |
| **2120** | Fine Ground Bone. | L. Sanderson, Long Wharf, New Haven. | Robt. Aitken, Shaker Station. | 35.00 |
| **1894** | Ground Bone. | L. Sanderson, Long Wharf, New Haven. | Manufacturer. | 35.00 |
| **1904** | Quinnipiac Bone Meal. | Quinnipiac Co., New London. | E. A. Godfrey, Southport.<br>R. B. Bradley, New Haven. | 36.00 |
| **1908** | Swift Sure Bone Meal. | M. L. Shoemaker & Co., Philadelphia. | F. Ellsworth, Hartford. | 40.00 |

## BONE MANURES.—SAMPLED BY STATION.

| Station No. | Name or Brand. | Manufacturer. | Dealer. | Cost per ton. |
|---|---|---|---|---|
| **2060** | Ground Bone. | Crocker Fertilizer & Chemical Works, Buffalo, N. Y. | J. E. Leonard, Jewett City.<br>G. S. Bragg, Canaan. | $40.00<br>38.00 |
| **2061** | Pure Ground Bone, A. X. Brand. | Rogers & Hubbard Co, Middletown. | Wilson & Burr, Middletown. | 32.00* |
| **1988** | Pure Ground Bone. | C. Meyer, Jr., Maspeth, L. I. | G. F. Platt, Milford.† | 35.00‡ |
| **1905** | Baker's Strictly Pure Bone. "A" | H. J. Baker & Bro., 215 Pearl Street, New York. | C. O. Jeliff & Co., Southport. | 35.00 |
| **1927** | Americus Brand Pure Bone Meal. | Williams & Clark Co., Hanover Square, New York City. | R. B. Bradley & Co., New Haven. | 36.00§ |
| **1906** | E. F. Coe's Ground Bone. | E. F. Coe, 16 Burling Slip, New York. | Simon Banks, Southport. | 28.00 |
| **2004** | E. F. Coe's Ground Bone. | E. F. Coe, 16 Burling Slip, New York. | J. F. Silliman, New Canaan.<br>Wheeler & Howes, Bridgeport.<br>D. P. Penfield, Danbury. | 35.00<br>32.00<br>35.00 |
| **1984** | Lister's Celebrated Ground Bone. | Lister Fertilizer and Chemical Works, Newark, N. J. | A. N. Clark, Milford. | 28.00 |
| **1907** | Darling's Fine Ground Bone. | L. B. Darling Fert. Co., Pawtucket, R. I. | R. B. Bradley & Co., New Haven. | |
| **1958** | Chittenden's Ground Bone or Fine Animal Bone. | National Fertilizer Co., Bridgeport. | Mattabesett Grange, Middletown. | |

* Sold by manufacturer for $30 *cash* f. o. b. Middletown. † From stock purchased for his own use. ‡ At Milford.
§ Manufacturer's price.

## ANALYSES OF BONE MANURES.—SAMPLED BY STATION.

| Station No. | Name or Brand. | Chemical Analysis. | | Mechanical Analysis. | | | | | Cost per ton. | Valuation per ton. | Percentage difference between cost and valuation. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Finer than | | | | Coarser than $\frac{1}{6}$ inch. | | | |
| | | Nitrogen. | Phos. Acid. | $\frac{1}{50}$ inch. | $\frac{1}{25}$ inch. | $\frac{1}{12}$ inch. | $\frac{1}{6}$ inch. | | | | |
| | | | | | | | | | | | Valuation exceeds cost. |
| **1967** | Peter Cooper's Pure Bone Dust | 1.34 | 31.35 | 44 | 18 | 22 | 16 | -- | $28.00 | $40.69 | 31.1 |
| **2136*** | H. J. Baker's Strictly Pure Bone | 3.89 | 23.38 | 73 | 27 | -- | -- | -- | 32.00‡ | 43.49 | 26.4 |
| **2125** | Armour's Bone | 3.31 | 26.56 | 51 | 21 | 23 | 5 | -- | 32.00 | 42.34 | 24.4 |
| **1903*** | H. J. Baker's Strictly Pure Ground Bone | 3.80 | 22.78 | 81 | 19 | -- | -- | -- | 35.00 | 42.90 | 18.4 |
| **2133†** | Quinnipiac Bone Meal | 2.82 | 26.00 | 67 | 19 | 13 | 1 | 0 | 36.00 | 42.38 | 15.5 |
| **1961** | Bradley's Fine Bone | 3.38 | 23.88 | 67 | 19 | 14 | -- | -- | 35.00 | 41.37 | 15.4 |
| **2120** | Sanderson's Fine Ground Bone | 3.94 | 22.07 | 60 | 40 | -- | -- | -- | 35.00 | 41.09 | 14.9 |
| **1894** | Sanderson's Ground Bone | 3.86 | 21.78 | 65 | 35 | -- | -- | -- | 35.00 | 40.78 | 14.1 |
| **1904†** | Quinnipiac Bone Meal | 2.59 | 25.54 | 65 | 19 | 16 | -- | -- | 36.00 | 40.91 | 12.0 |
| **1908** | Shoemaker's Swift Sure Bone Meal | 6.57 | 19.44 | 65 | 25 | 10 | -- | -- | 40.00 | 45.31 | 11.7 |
| **2060** | Crocker Fertilizer and Chemical Works, Ground Bone | 3.79 | 24 65 | 56 | 24 | 20 | -- | -- | 38.00 | 42.51 | 10.6 |
| **2061** | Rogers & Hubbard Pure Ground Bone, Grade AX Brand | 3.79 | 22.01 | 28 | 26 | 26 | 20 | -- | 32.00 | 34.78 | 8.0 |
| **1938** | C. Meyer's Pure Ground Bone | 3.49 | 19.47 | 60 | 40 | -- | -- | -- | 35.00 | 36.31 | 3.6 |
| **1905*** | H. J. Baker's "A" Strictly Pure Bone | 3.44 | 18.81 | 67 | 32 | 1 | -- | -- | 35.00 | 35.59 | 1.6 |
| **1927** | Americus Brand Pure Bone Meal | 4.44 | 18.24 | 58 | 22 | 16 | 4 | -- | 36.00 | 36.17 | .5 |
| | | | | | | | | | | | Cost exceeds valuation. |
| **1906** | E. F. Coe's Ground Bone | 2.73 | 14.85§ | 54 | 19 | 15 | 8 | 4 | 28.00 | 27.98 | .1 |
| **2004** | E. F. Coe's Ground Bone | 3.16 | 14.24‖ | 64 | 18 | 10 | 8 | -- | 32–35 | 29.88 | 12.1 |
| **1934** | Lister's Celebrated Ground Bone | 2.90 | 12.82 | 38 | 20 | 20 | 22 | -- | 28.00 | 22.54 | 24.2 |
| **1907** | Darling's Fine Ground Bone | 3.00 | 24.51 | 79 | 19 | 2 | -- | -- | ---- | 42.51 | ---- |
| **1958** | Chittenden's Fine Animal Bone | 3.55 | 23.72 | 43 | 24 | 21 | 12 | -- | ---- | 38.28 | ---- |

* Compare the three analyses **1903, 1905** and **2136** in this table.

† Compare the two analyses **2133** and **1904** in this table.

‡ Regular price $35.00.

§ Also contains 2.46 per cent. of potash.

‖ Also contains 2.80 per cent. of potash.

## ANALYSES OF MANUFACTURERS' SAMPLES OF BONE MANURES.

| Station No. | Name or Brand. | Chemical Analysis. | | Mechanical Analysis. | | | | | Valuation per Ton. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Finer than | | | | Coarser than $\frac{1}{6}$ inch. | |
| | | Nitrogen. | Phos. Acid. | $\frac{1}{50}$ inch. | $\frac{1}{25}$ inch. | $\frac{1}{12}$ inch. | $\frac{1}{6}$ inch. | | |
| **2123** | L. M. Meyer's Bone Manure | 4.20 | 20.83 | 53 | 23 | 18 | 6 | -- | $37.99 |
| **2127** | G. W. Miller's Pure Ground Bone | 3.93 | 22.52 | 23 | 14 | 26 | 37 | -- | †33.35 |
| **2078** | C. Prentice's Bone | 4.09 | 22.04 | 39 | 35 | 17 | 9 | -- | 38.14 |
| **2153** | The Rogers & Hubbard Co's Pure Raw Knuckle Bone Flour | 3.82 | 25.61 | 76 | 21 | 3 | -- | -- | *46.28 |

* Cost $37 f. o. b. Middletown.

† Cost $32 per ton.

### BONE AND POTASH.

Two samples of bone containing potash, No. **1906** and **2004**, have been classed with the bone manures already discussed, because sold as "bone."

**2154.** Fairchild's Formula Bone and Potash made by the Rogers & Hubbard Co., Middletown. Sampled by the manufacturer.

#### MECHANICAL ANALYSIS.

| | | | |
|---|---|---|---|
| Fine, smaller than | 1/50 | inch | 36 |
| Fine medium, smaller than | 1/25 | " | 17 |
| Medium, smaller than | 1/12 | " | 33 |
| Coarse medium, smaller than | 1/6 | " | 14 |
| | | | 100 |

#### CHEMICAL ANALYSIS AND VALUATION.

| | | |
|---|---|---|
| Nitrogen | 2.60 | per cent. |
| Phosphoric Acid | 16.25 | " |
| Potash | 17.70 | " |
| Valuation | $10.75 | |
| Cost | 35.00 | |

### TANKAGE.

This material consists of various kinds of offal but chiefly of cooked bone and meat which collects on the bottom of the tanks in which grease is separated from the waste of slaughter-houses and meat markets. As the analyses show it varies greatly in composition. On the valuation of Tankage see page 91.

**1960.** No. 1, sold by National Fertilizer Co., Bridgeport, to the Meriden Grange.

**1959.** No. 2, sold by National Fertilizer Co., to the Meriden Grange.

**1889.** Western Tankage from stock of L. Sanderson, New Haven.

**1891.** New York Tankage from stock of L. Sanderson, New Haven.

**2122.** Sold by L. Sanderson, New Haven, to Robert Aitkin, Shaker Station.

**1946.** Made by Sperry & Barnes, New Haven. From lot bought by G. F. Platt, Milford.

**1948.** Made by Sperry & Barnes. From lot bought by H. E. Bassett, New Haven.

### MECHANICAL ANALYSES.

| | 1960 | 1959 | 1889 | 1891 | 2122 | 1946 | 1948 |
|---|---|---|---|---|---|---|---|
| Fine, smaller than $\frac{1}{50}$ inch | 46 | 54 | 65 | 75 | 72 | 46 | 54 |
| Fine medium, smaller than $\frac{1}{25}$ inch | 29 | 23 | 22 | 14 | 15 | 19 | 21 |
| Medium, smaller than $\frac{1}{12}$ inch | 20 | 17 | 12 | 9 | 11 | 14 | 13 |
| Coarse medium, smaller than $\frac{1}{6}$ inch | 5 | 6 | 1 | 2 | 2 | 10 | 6 |
| Coarse, larger than $\frac{1}{6}$ inch | 0 | 0 | 0 | 0 | 0 | 11 | 6 |
| | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

### CHEMICAL ANALYSES AND VALUATIONS.

| | 1960 | 1959 | 1889 | 1891 | 2122 | 1946 | 1948 |
|---|---|---|---|---|---|---|---|
| Nitrogen | 7.51 | 6.52 | 7.46 | 5.38 | 5.53 | 8.20 | 8.99 |
| Phosphoric acid | 9.02 | 15.60 | 12.44 | 19.24 | 18.83 | 5.98 | 4.76 |
| Cost per ton | $ | | 38.00 | 38.00 | 35.00 | 25.00 | 26.00 |
| Valuation per ton | $32.62 | 38.40 | 38.60 | 41.87 | 41.47 | 29.18 | 31.39 |

## ANIMAL DUST.

*Sampled by private individuals.*

**1984**. Finest Animal Dust. Sampled by S. T. Stockwell, Simsbury.

**1982**. Animal Dust. Sampled by J. C. Eddy, Simsbury. Both made by the L. B. Darling Fertilizer Co., Pawtucket R. I., and bought direct from the company.

### MECHANICAL ANALYSES.

| | 1984 | 1982 |
|---|---|---|
| Fine, smaller than $\frac{1}{50}$ inch | 41 | 31 |
| Fine medium, smaller than $\frac{1}{25}$ " | 18 | 14 |
| Medium, smaller than $\frac{1}{12}$ " | 24 | 32 |
| Coarse medium, smaller than $\frac{1}{6}$ " | 17 | 23 |
| | 100 | 100 |

### ANALYSES AND VALUATIONS.

| | 1984 | 1982 |
|---|---|---|
| Nitrogen | 6.01 | 5.72 |
| Phosphoric acid | 10.96 | 12.59 |
| Cost per ton | $27.00 | 27.00 |
| Valuation per ton | $29.19 | 28.85 |

### DRIED BLOOD.

Pure dried blood, prepared at large slaughter houses by drying the blood with superheated steam, contains from 10 to 15 per cent. of nitrogen, depending on the degree of dryness. It contains besides the animal tissue of which the nitrogen forms a part, a small fraction of a per cent. each of phosphoric acid and potash, and from 8 to 15 or more per cent. of water. It is sold usually on a guarantee of so many "units of ammonia." For explanation of this term, see page 87. "Blood and Meat," "Blood and Bone," etc., as their names imply, are different things, being mixtures of various kinds of slaughter-house offal containing less nitrogen and often considerable quantities of phosphoric acid from bones.

**2007**. Stock of C. M. Beach, West Hartford. Last years' stock used in home mixtures described further on.

**2124**. Made by Armour & Co., Chicago, Ill. Stock of R. A. Moore, Berlin.

**2149**. Sold by Bradley Fertilizer Co., Boston, Mass. Stock of A. A. Hubbard, Canaan.

**1914**. Stock of L. Sanderson, New Haven.

ANALYSES.

| | **2007** | **2124** | **2149** | **1914** |
|---|---|---|---|---|
| Nitrogen | 9.15 | 13.04 | 11.21 | 12.65 |
| Cost per ton | $34.40* | 38.00 | 38.00 | 43.00 |
| | cts. | cts. | cts. | cts. |
| Nitrogen costs per pound | 18.8 | 14.6 | 16.9 | 17.0 |

* Including freight to farm.

### TALLOW SCRAP.

A sample of wet meat **1902**, from a rendering establishment, brought to the station by Mr. J. H. Dickerman of Mt. Carmel, contained—

| | | |
|---|---|---|
| Water | 66.00 | per cent. |
| Nitrogen | 3.07 | " |
| Phosphoric acid | 1.18 | " |

The material could only be well used for composting, being too coarse for direct application to the land.

## CASTOR POMACE.

This is the ground residue or cake of castor beans from which castor oil has been extracted by pressure.

**2059.** Made by H. J. Baker & Bro., New York. Stock of W. W. Clark, Simsbury.

**1995.** Made by Collier White Lead and Oil Co., St. Louis, Mo. Stock of F. Ellsworth, Hartford.

**1994.** Made by St. Louis Lead and Oil Co., St. Louis, Mo. Stock of Olds & Whipple, Hartford.

### ANALYSES AND VALUATIONS.

| | 2059 | 1995 | 1994 |
|---|---|---|---|
| Nitrogen | 5.86 | 5.70 | 5.77 |
| Phosphoric Acid | 1.99 | 1.70 | 1.87 |
| Potash | 1.07 | 1.02 | 1.00 |
| Cost per ton | $19–20 | $20.00 | $19.00 |
| Valuation per ton | $24.21 | $23.20 | $23.67 |

These three samples from different manufacturers show a close agreement in composition. For valuation, nitrogen has been reckoned at 17½ cents, phosphoric acid at 7 cents (as in fine bone and in fish scrap) and potash at 4¼ cents per pound. If these valuations are given to the phosphoric acid and potash, then the actual average cost of nitrogen in these samples is 14.1 cents per pound, which shows that the pomace has been this year the cheapest form of readily available nitrogen in the Connecticut market.

## NITRATE OF SODA.

Nitrate of Soda is mined in Chili and purified there before shipment. It contains usually about 16 per cent. of nitrogen, equivalent to 97 per cent. of pure nitrate of soda. It contains besides, a little salt and some moisture. The usual guarantee is "96 per cent." of nitrate of soda equivalent to 15.8 per cent. of nitrogen.

**1915.** Stock of L. Sanderson, New Haven.

**1956.** Sold by National Fertilizer Co., Bridgeport, to Mattabesett Grange, Middletown.

**2145.** Sold by the Quinnipiac Co., New London. Stock of Wilson & Burr, Middletown.

**2146.** Sold by Mapes Branch, Hartford.

ANALYSES.

| | 1915 | 1956 | 2145 | 2146 |
|---|---|---|---|---|
| Water | 1.45 | 2.20 | 1.40 | 1.00 |
| Salt | .39 | .84 | 1.25 | 1.09 |
| Sulphate of Soda | .27 | .30 | .25 | .53 |
| Nitrate of Soda | 97.89 | 96.66 | 97.10 | 97.38 |
| | 100.00 | 100.00 | 100.00 | 100.00 |
| Nitrogen | 16.12 | 15.92 | 15.99 | 16.04 |
| Cost per ton | $55.00 | | 52.50 | 60.00 |
| Nitrogen costs per pound, cts. | 17.0 | | 16.4 | 18.7 |

## SULPHATE OF AMMONIA.

This article, now manufactured on a large scale as a by-product of gas-works, usually contains over 20 per cent. of nitrogen, the equivalent of from 94 to 97 per cent. of sulphate of ammonia. The rest is chiefly moisture. The usual guarantee is 25 per cent. of ammonia which is equivalent to 20.6 per cent. of nitrogen, but commercial sulphate of ammonia commonly contains less than that quantity.

**1940.** Made by C. Meyer Jr., Maspeth, L. I. Stock of G. F. Platt, Milford.

**1911.** Stock of L. Sanderson, New Haven.

**2144.** Stock of Mapes Branch, Hartford.

ANALYSES.

| | 1940 | 1911 | 2144 |
|---|---|---|---|
| Nitrogen | 20.37 | 20.37 | 19.93 |
| Equivalent Ammonia | 24.74 | 24.74 | 24.20 |
| Cost per ton | $72.48* | 70.00 | 73.00 |
| | cts. | cts. | cts. |
| Nitrogen costs per pound | 18.3 | 17.1 | 18.3 |

* Including freight from N. Y.

## DOUBLE SULPHATE OF POTASH AND MAGNESIA.

This article is usually sold as "sulphate of potash" on a guarantee of "48–50 per cent. sulphate" which is equivalent to 25.9–27 per cent. of actual potash. It contains, besides some 46–50 per cent. of sulphate of potash, over 30 per cent. of sulphate of magnesia,* chlorine equivalent to 3 per cent. of common salt, besides sulphates of soda and lime, with varying quantities of moisture.

**1892.** Stock of L. Sanderson, New Haven.

**1945.** Sold by C. Meyer, Jr., Maspeth, L. I. Stock of G. F. Platt, Milford.

**1951.** Sold by National Fertilizer Co., Bridgeport, to Mattabesett Grange, Middletown.

**1952.** Sold by National Fertilizer Co., Bridgeport, to Meriden Grange.

**2137.** Sold by Williams, Clark & Co., New York. Stock of E. M. Jennings, Southport.

**2138.** Sold by Williams, Clark & Co., New York. Stock of Strong & Backus, Colchester.

ANALYSES.

| | **1892** | **1945** | **1951** | **1952** | **2137** | **2138** |
|---|---|---|---|---|---|---|
| Potash | 27.17 | 25.03 | 26.34 | 26.82 | 26.34 | 26.08 |
| Equivalent Sulphate of Potash | 50.2 | 46.3 | 48.7 | 49.6 | 48.7 | 48.2 |
| Chlorine | .... | 1.88 | 1.80 | 1.80 | .... | .... |
| Cost per ton | $30.00 | 37.00* | .... | .... | .... | 35.00 |
| Potash costs per pound, cts. | 5.5 | 7.3 | .... | .... | .... | 6.7 |

* $35.00 f. o. b. in N. Y.

### MURIATE OF POTASH.

Commercial muriate of potash contains about 80 per cent. of muriate of potash (potassium chloride), 15 per cent. or more of common salt (sodium chloride), and 4 per cent. or more of water. It is generally retailed on a guarantee of 80 per cent. muriate, which is equivalent to 50.5 per cent. of actual potash.

**1928.** Sold by H. J. Baker & Bro., New York. Stock of R. B. Bradley & Co., New Haven. Dealer declined to quote retail price.

**2140.** Sold by H. J. Baker & Bro., New York. Stock of C. O. Jeliff & Co., Southport.

**1943.** Sold by H. J. Baker & Bro., New York. Stock of Dennis Fenn, Milford.

**2141.** Sold by the Mapes Branch, Hartford.

**1944.** Sold by C. Meyer, Jr., Maspeth, Long Island. Stock of G. F. Platt, Milford.

---

* Epsom salt is crystallized hydrated sulphate of magnesia, with 51 per cent. water of crystallization.

**2062.** Sold by Quinnipiac Fertilizer Co., New London. Stock of Wilson & Burr, Middletown.

**1890.** Sold by L. Sanderson, New Haven. Sampled in February.

**2121.** Sold by L. Sanderson. Sampled in September.

**1953.** Sold by National Fertilizer Co. Stock of Mattabesett Grange, Middletown.

**2139.** Sold by Williams, Clark & Co., New York. Stock of E. M. Jennings, Southport.

### ANALYSES.

| | 1928 | 2140 | 1943 | 2141 | 1944 | 2062 | 1890 | 2121 | 1953 | 2139 |
|---|---|---|---|---|---|---|---|---|---|---|
| Potash | 51.17 | 51.67 | 50.40 | 53.73 | 51.77 | 48.85 | 50.88 | 51.33 | 52.95 | 51.27 |
| Equivalent Muriate of Potash | 80.8 | 81.9 | 79.7 | 84.9 | 82.0 | 77.2 | 80.6 | 81.4 | 83.9 | 80.9 |
| Cost per ton, $ | | 42.00 | 45.00 | 45.00 | 43.50 | 42.50 | 42.50 | 41. 0 | .... | .... |
| Potash costs per pound, cts. | | 4.1 | 4.4 | 4.2 | 4.2 | 4.4 | 4.2 | 4.0 | .... | .... |

Muriate of potash is generally sold in the same packages in which it is received from Germany, or is merely rebagged by importers without manipulation. The differences in composition are due in part to variations in the freshly manufactured article, and in part to accidents in shipment.

### KAINIT.

Kainit is less uniform in composition than the other potash salts. It contains from 11 to 15 per cent. of potash, more than that quantity of soda, and rather less magnesia. These "bases" are combined with chlorine and sulphuric acid. It also usually contains more water than the sulphate or muriate of potash. It is usually sold on a guarantee of 12 to 15 per cent. of potash, or 23 to 25 per cent. "sulphate of potash." It cannot properly be called or be used as a sulphate of potash, because it contains more than enough chlorine to combine with all the potash present and there is every reason to believe that its potash exists as muriate and not as sulphate.

**1929.** Sold by H. J. Baker & Bro., New York. Stock of C. O. Jeliff & Co., Southport.

**2147.** Sold by Quinnipiac Co., New London. Stock of E. A. Godfrey, Southport.

**1913.** Stock of L. Sanderson, New Haven.

**1955.** Sold by National Fertilizer Co., Bridgeport, to Meriden Grange.

**2148.** Sold by Williams, Clark & Co., New York. Stock of E. M. Jennings, Southport.

### ANALYSES OF KAINIT.

| | 1929 | 2147 | 1913 | 1955 | 2148 |
|---|---|---|---|---|---|
| Potash | 12.41 | 12.82 | 12.26 | 12.42 | 13.07 |
| Cost per ton | $13.00 | 12.00 | 11.50 | .... | .... |
| Potash costs per pound, cts. | 5.2 | 4.7 | 4.7 | .... | .... |

### COTTON HULL ASHES.

**1924.** From stock of W. W. Cooper and E. A. Russell, Suffield. Sampled by Station Agent.

**1896.** Sampled and sent by Dwight S. Fuller, Suffield. Received by him from Mr. Charles, New Orleans, La.

**1899.** From Stock of F. C. Harmon. Sampled and sent by Edmund Halladay, Suffield.

**1926.** Mixture of three samples from stock of J. Fröhlinger, E. A. Russell and F. E. Granger, all of Suffield. These lots were all bought of F. C. Harmon, Suffield.

**1950.** From stock of Olds & Whipple, Hartford. Sampled and sent by C. H. Cables, Thomaston.

**1962.** From stock of Olds & Whipple, Hartford. Sampled and sent by L. G. Goodrich, Simsbury.

**1979.** From stock of R. A. Parker, Warehouse Point. Sampled and sent by John Mason, Warehouse Point.

**1923.** From stock of R. E. Pinney, Suffield. Sampled and sent by C. D. Woodworth, Thompsonville.

**1925.** Mixture of two samples. One from stock of R. E. Pinney, the other from stock sold by him to E. A. Russell, Suffield. Sampled by Station Agent.

**1963.** From stock bought by H. B. Wakeman, Greens Farms, of American Oil Co., of New York. Sampled and sent by Station Agent.

### Cotton Hull Ashes—Analyses and Valuation.

| | **1924** | **1896** | **1899** | **1926** | **1950** | **1962** | **1979** | **1923** | **1925** | **1963** |
|---|---|---|---|---|---|---|---|---|---|---|
| Soluble Phosphoric Acid | 1.72 | 1.57 | .91 | .51 | 1.65 | .64 | .40 | .75 | 2.08 | 1.44 |
| Reverted Phosphoric Acid | 6.44 | 7.63 | 4.00 | 5.15 | 7.06 | 6.78 | 6.78 | 5.67 | 6.90 | 6.33 |
| Insoluble Phosphoric Acid | .74 | 1.42 | .09 | .96 | 2.40 | 1.42 | 1.77 | 1.51 | 1.85 | .59 |
| Potash Soluble in Water | 12.54 | 18.97 | 32.79 | 28.58 | 21.54 | 27.72 | 21.43 | 20.91 | 21.36 | 26 73 |
| Cost per ton | $35.00 | 35.00 | 33.00 | 33.00 | 35.00 | .... | 35.00 | 35.00 | 35.00 | 30.00 |
| Valuation per ton | 26.50 | 35.39 | 43.57 | 40.36 | 37.88 | 42.25 | 35.09 | 33.30 | 37.92 | 41.44 |

Soluble phosphoric acid in the ashes is valued at 8 cents per pound, reverted at 7½ cents and insoluble at 2 cents per pound. The potash being free from chlorides is valued at 5½ cents. As in past years the ashes vary greatly in composition, but are an excellent source of potash, especially for tobacco growers. The ashes sold by the American Oil Co. and by R. E. Pinney are in good condition mechanically, being free from the large hard lumps which are common in crude cotton hull ashes.

### Cayuga Land Plaster.

**1947.** Made by Cayuga Plaster Co., Union Springs, New York. Sampled by H. J. Mattoon, Watertown., from stock sold by him. Cost $7.00 per ton.

| | |
|---|---|
| Pure Hydrated Sulphate of Lime | 66.50 |
| Sand and Insoluble Matters | 6.27 |
| Other Matters, chiefly Carbonate of Lime | 27.23 |
| | 100.00 |

The sample has about the average composition of Cayuga Plaster, which usually differs from Nova Scotia Plaster chiefly in containing a larger quantity of carbonates.

### Unleached Hardwood Ashes.

**1910.** Sold by Charles Stevens, Napanee, Canada. Stock of T. R. Dawley, Griswold.

**2084.** Sold by Charles Stevens. Sampled from stock at Shaker Station.

**2135.** Sold by Charles Stevens, Napanee, Canada. From stock bought by Augustus Meeker, Southport, and sampled and sent by him.

**1897.** Sold by James Hartness, Detroit, Mich. Sampled by W. H. Burr, Westport.

**2134.** Sold by E. M. Jennings, Southport. Sampled and sent by Augustus Meeker, Southport.

**2152.** Sold by Irwin Jennings. Sampled and sent by E. O. Wakeman, Westport.

| | 1910 | 2084 | 2135 | 1897 | 2134 | 2152 |
|---|---|---|---|---|---|---|
| Water | 11.99 | --- | --- | 10.84 | --- | --- |
| Phosphoric acid | 1.61 | 1.38 | 1.56 | 1.66 | 1.44 | .98 |
| Potash soluble in water | 7.67 | 5.58 | 7.01 | 5.34 | 4.96 | 4.95 |
| Sand and soil | 9.05 | --- | --- | 15.40 | --- | |
| Cost per ton | $12.00 | 15.00* | 11.50* | 11.00 | 11.50* | |

## LIME KILN ASHES.

**2012.** Made in New York State. From E. M. Jennings, Southport.

| | |
|---|---|
| Phosphoric acid | 1.66 |
| Potash | 1.24 |
| Sand and soil | 5.40 |
| Coal, etc. | 2.80 |
| Water | 22.45 |

* In car lots.

## CORN COB ASHES.

**1886.** Sampled and sent by W. W. Pease, Thompsonville.

| | |
|---|---|
| Potash soluble in water | 12.87 |
| Phosphoric acid | 2.26 |
| Sand, soil and coal | 34.65 |

Cost $25 per ton.

The agricultural value of ashes generally depends not merely on the quantity of potash and phosphoric acid they contain, but also consists in their favorable effect on the mechanical condition of the soil, and especially in their serving to supply lime to the soil and to the crop, in the form of carbonate.

## ANALYSIS OF TOBACCO STALKS, NO. 1895.

On the 17th of February, Mr. Byron Loomis brought to this Station a sample of Tobacco Stalks, in regard to which he stated as follows:—The stalks are from Havana Seed Tobacco raised in Suffield, planted in rows 3½ feet apart, the plants 18–20 inches apart in the row. The sample represents 50 average stalks after they have been cured, and weighs 20 pounds. From Mr. Loomis's statement it appears that there were between 7100 and 7900 stalks to the acre or 7500 on the average, and accordingly their weight at the date would be about 3000 pounds or 1½ tons to the acre. The analysis follows, and for comparison is also given an analysis of stalks of Connecticut Leaf, Havana Seed, Tobacco, which were supplied to the Station by Mr. H. H. Austin, of Suffield. The analysis, with a different water content is found on page 105 of the Report for 1884. Mr. Austin's sample was much drier than Mr. Loomis's sample, containing only 45.90 per cent. of water. The analysis is here reckoned to 67.00 per cent. of water for comparison. Mr. Austin also estimates the weight of the [drier] stalks at 4000 pounds per acre. These differences in estimated total yield and in the water-content of the stalks account largely for the difference in the yield of plant food per acre as calculated from the analysis.

| | Mr. Loomis's Sample. | Mr. Austin's Sample. |
|---|---|---|
| Water | 66.99 | 67.00 |
| Organic and Volatile Matter | 29.96 | 30.06 |
| Containing Nitrogen | [.69] | [.13] |
| Ash or Mineral Matter | 3.05 | 2.94 |
| | 100.00 | 100.00 |

The mineral matter contains:

| | Mr. Loomis's Sample. | Mr. Austin's Sample. |
|---|---|---|
| Potash | 1.37 | 1.60 |
| Soda | .02 | .01 |
| Lime | .29 | .30 |
| Magnesia | .15 | .19 |
| Oxide of Iron | .04 | -- |
| Phosphoric acid | .18 | .22 |
| Sulphuric acid | .16 | .23 |
| Chlorine | .34 | .33 |
| Sand and Silica | .58 | .13 |
| | 3.13 | 3.01 |
| Deduct oxygen equivalent to chlorine | .08 | .07 |
| | 3.05 | 2.94 |

From the data given by Mr. Loomis the amount of plant food contained in the stalks, furnished by him is calculated as follows, for the produce of an acre:

| | | |
|---|---|---|
| Nitrogen | 20.6 | pounds. |
| Phosphoric acid | 5.4 | " |
| Potash | 41.0 | " |
| Soda | .5 | " |
| Lime | 7.8 | " |
| Magnesia | 4.4 | " |
| Sulphuric acid | 4.7 | " |
| Chlorine | 10.3 | " |

The stalks therefore contain about as much nitrogen and potash as would be furnished by an application of 70 pounds of muriate of potash and 300 pounds of cotton seed meal per acre. The latter would, however, contain nearly twice as much phosphoric acid.

## MUCK FROM FLORIDA.

The two following analyses were made in the interest of citizens of Connecticut, who are engaged in orange culture in Florida. Under date of July 14, Mr. Cyrus Pickett of New Haven, writes in regard to the samples: "No. 1 consists of rotted leaves and plants in what are called "Bays," that cover millions of acres in Florida. No. 4 is from "Ponds" that are really a kind of muck or peat beds into which you can press a pole ten or fifteen feet sometimes.

"Is it true that there are acids in them that do as much hurt to orange trees as the valuable elements do good?"

The results of analysis were as follows:

**2104.** Muck from "Bays" in Florida, No. 1.

**2107.** Muck from "Ponds" in Florida, No. 4.

| Station No. | **2104** | **2107** |
|---|---|---|
| Water | 13.90 | 6.19 |
| Organic and volatile matter* | 70.82 | 37.50 |
| Ash | 15.28 | 56.31 |
| | 100.00 | 100.00 |
| * Containing nitrogen | 1.67 | 1.26 |

The ash is made up of:

| | | |
|---|---|---|
| Sand and soil | 12.75 | 54.20 |
| Iron Oxide | trace | trace |
| Lime | .38 | .18 |
| Magnesia | .68 | .49 |
| Phosphoric acid | .18 | .19 |
| Other matters not separately determined | 2.29 | 1.25 |
| | 16.28 | 56.31 |

**2104** has a faintly acid reaction. No soluble iron salts.

**2107** has a faintly acid reaction. There is a bare trace of soluble iron salts.

To Mr. Pickett was written substantially as follows:

"The analyses represent the peat in a comparatively dry condition. No. 1 is much richer in vegetable matter than No. 4, has therefore more nitrogen and is probably the more valuable agriculturally. On the dry sandy lands near the deposits these mucks will prove a valuable amendment, making the soil more retentive of moisture and at the same time richer in plant food. The peat should be thrown out to dry some time before it is to be used so as to give it time to weather and become crumbly and mellow. If horse manure, urine or old fashioned guano are at your disposal, composting the peat with either of these things will much improve it. At present the nitrogen in the peat is no doubt mostly in an inert form and composting will make it more readily available."

It may be added that the "injurious acids" of peat or swamp muck commonly consist of acid salts of iron or alumina which are rendered harmless by exposure to air and rain and by composting with animal manures or with lime.

## REVIEW OF THE FERTILIZER MARKET

### FOR THE YEAR ENDING DEC. 1, 1887.

### NITROGEN.

### *Organic Nitrogen.*

The nitrogen of *Dried Blood* was quoted *at wholesale* in the New York market in December, 1886, at about 13.3 cents per pound. It rose to 13.6 cents in April, which was the highest figure for the year, declined to 13.1 cents in June, 12.6 cents in August and 12.1 cents in September.

The *wholesale* quotation of nitrogen in *azotin* has ruled somewhat higher, 14.5 cents in December of last year, 14.1 in April, 13.4 in August and 12.3 in October.

The wholesale cost of organic nitrogen the year through has been considerably under 14 cents per pound.

The *retail price* of the nitrogen of dried blood in three samples form the Connecticut market has been from 14.6 to 17 cents per pound. It is sold in New Haven at 17 cents per pound at this time (Dec. 1). Castor Pomace has been freely sold in the State this season at prices which make its nitrogen cost a trifle over 14 cents.

### *Nitric Nitrogen.*

The *wholesale* price in the New York market of nitrogen in *Nitrate of Soda* was 13.1 cents per pound in December of last year. It rose in February to 13.6, in March to 14.3, and in April to 14.9. It then gradually declined to 11.8 cents in August, rallied in the next two months to 13.0 and is now quoted at 12.7.

Its *retail* price in this State has been from 16.4 to 18.7 cents per pound. It is offered freely at 17 cents.

### *Ammonic Nitrogen.*

The *wholesale* price in New York of nitrogen in *Sulphate of Ammonia* has been quite constant, fluctuating between 14.5 and 14.9 cents during the entire year, the average price being about 14.6 cents.

The *retail* cost in this State has been from 17.1 to 18.3 cents.

## PHOSPHATIC MATERIALS.

*Refuse Bone Black* stood at $18.50 per ton wholesale till September when it fell to $17.75.

*Ground Bone* at the same time fell from $29.50 to $28.50.

*Ground Charleston Rock, f.o.b., N. Y.*, fell in September from $8.25 to $7.50 and in October to $6.25.

*Sulphuric Acid*, 66° fell in May from 1·17½ cts. per pound wholesale to 1.07½.

## POTASH.

### *In Muriate of Potash.*

Potash *at wholesale* in this form was quoted at the beginning of the year at 3.41 cents per pound. It rose in April to 3.56, declined in June to 3.41 again and in September to 3.36. Its *retail* price in the State has been from 4 to 4.4 cents per pound during the year.

### *In Double Sulphate of Potash and Magnesia.*

Potash *at wholesale* in this form has sold at from 4.05 to 4.15 cents per pound in New York.

Its *retail* price in the State has been from 5.5 to 7.3 cents per pound. Apparently it is not retailed at nearly so close a margin as the muriate.

### *In Kainit.*

The *wholesale* price of Kainit has been from $7.37 to $7.87 per ton. Assuming that Kainit averages 12.4 per cent. of potash the *wholesale* cost of actual potash in kainit has been from 3.0 to 3.17 cents per pound. The *retail* cost in the State has been from 4.7 to 5.2 cents per pound. Kainit at present prices is a less economical source of potash than muriate and so far as its potash goes is in no way superior to the muriate.

In general there has been no striking change in the wholesale fertilizer market during the year in the quotations of potash and phosphoric acid.

Nitrogenous matters, except sulphate of ammonia, have been noticeably cheaper than in the previous year.

The market quotations given above are taken from the "Oil, Paint and Drug Reporter," published in New York. The weekly quotations for each month are averaged and this average is taken as the quotation for the month.

The following explanations will be helpful in the examination of the market quotations, and will also serve to show the basis on which they have been interpreted in this review:

*Phosphate rock, kainit, bone, fish-scrap, tankage*, and some other articles are quoted and sold by the ton. The seller usually has an analysis of his stock and purchasers often control this by an analysis at the time of purchase.

*Sulphate of ammonia, nitrate of soda and muriate of potash* are quoted and sold by the pound, and generally their wholesale and retail rates do not differ very widely.

*Blood, azotin and ammonite* are quoted at so much "per unit of ammonia." To reduce ammonia to nitrogen, multiply the per cent. of ammonia by the decimal .824 (or multiply the percentage of ammonia by 14 and divide that product by 17). A "unit of ammonia" is one per cent., or 20 pounds per ton. To illustrate: if a lot of tankage has 7.0 per cent. of nitrogen, equivalent to 8.5 per cent. of ammonia, it is said to contain 8½ units of ammonia, and if it is quoted at $2.25 per unit, a ton of it will cost 8½×2.25 =$19.13.

The term "ammonia" is *properly* used only in those cases where the nitrogen actually exists in the form of ammonia, but it is a usage of the trade to reckon all nitrogen, in whatever form it occurs, as ammonia.

To facilitate finding the actual cost of nitrogen per pound from the cost per unit of ammonia in the market reports, the following table is given.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ammonia at | $3.80 | per unit | is equivalent | to nitrogen at | 23.0 | cts. | per lb. |
| " | 3.70 | " | " | " | 22.4 | " | " |
| " | 3.60 | " | " | " | 21.8 | " | " |
| " | 3.50 | " | " | " | 21.2 | " | " |
| " | 3.40 | " | " | " | 20.6 | " | " |
| " | 3.30 | " | " | " | 20.0 | " | " |
| " | 3.20 | " | " | " | 19.4 | " | " |
| " | 3.10 | " | " | " | 18.8 | " | " |
| " | 3.00 | " | " | " | 18.2 | " | " |
| " | 2.90 | " | " | " | 17.6 | " | " |
| " | 2.80 | " | " | " | 17.0 | " | " |
| " | 2.70 | " | " | " | 16.4 | " | " |
| " | 2.60 | " | " | " | 15.8 | " | " |
| " | 2.50 | " | " | " | 15.2 | " | " |
| " | 2.40 | " | " | " | 14.6 | " | " |
| " | 2.30 | " | " | " | 14.0 | " | " |
| " | 2.20 | " | " | " | 13.4 | " | " |
| " | 2.10 | " | " | " | 12.8 | " | " |
| " | 2.00 | " | " | " | 12.2 | " | " |
| " | 1.90 | " | " | " | 11.6 | " | " |
| " | 1.80 | " | " | " | 11.0 | " | " |

Commercial Sulphate of Ammonia contains on the average 20.5 per cent. of nitrogen, though it is found to vary considerably in quality. When it has that amount of nitrogen (equivalent to 24.3 per cent. of ammonia),

| | | | | | |
|---|---|---|---|---|---|
| At | 4¾ | cents per lb. | Nitrogen | costs | 23.1 | cents per lb. |
| " | 4⅝ | " | " | " | 22.5 | " |
| " | 4½ | " | " | " | 21.9 | " |
| " | 4⅜ | " | " | " | 21.3 | " |
| " | 4¼ | " | " | " | 20.7 | " |
| " | 4⅛ | " | " | " | 20.1 | " |
| " | 4 | " | " | " | 19.5 | " |
| " | 3⅞ | " | " | " | 18.9 | " |
| " | 3¾ | " | " | " | 18.3 | " |
| " | 3⅝ | " | " | " | 17.6 | " |
| " | 3½ | " | " | " | 17.0 | " |
| " | 3⅜ | " | " | " | 16.4 | " |

| | | | | | | |
|---|---|---|---|---|---|---|
| At | 3¼ | cents per lb. | Nitrogen | costs | 15.8 | cents per lb. |
| " | 3⅛ | " | " | " | 15.2 | " |
| " | 3 | " | " | " | 14.6 | " |
| " | 2⅞ | " | " | " | 14.0 | " |
| " | 2¾ | " | " | " | 13.4 | " |

Commercial Nitrate of Soda averages 95 per cent. of the pure salt or 15.6 per cent. of nitrogen.

| | | | | | | |
|---|---|---|---|---|---|---|
| If quoted at | 3⅜ | cents per lb. | Nitrogen | costs | 21.5 | cents per lb. |
| " | 3¼ | " | " | " | 20.8 | " |
| " | 3⅛ | " | " | " | 19.9 | " |
| " | 3 | " | " | " | 19.2 | " |
| " | 2⅞ | " | " | " | 18.3 | " |
| " | 2¾ | " | " | " | 17.6 | " |
| " | 2⅝ | " | " | " | 16.9 | " |
| " | 2½ | " | " | " | 16.0 | " |
| " | 2⅜ | " | " | " | 15.2 | " |
| " | 2¼ | " | " | " | 14.4 | " |
| " | 2⅛ | " | " | " | 13.6 | " |
| " | 2 | " | " | " | 12.8 | " |
| " | 1⅞ | " | " | " | 12.0 | " |
| " | 1¾ | " | " | " | 11.2 | " |

Commercial Muriate of Potash usually has 80 per cent. of the pure salt, or 50½ per cent. of actual potash.

| | | | | | | |
|---|---|---|---|---|---|---|
| If quoted at | 2.00 | cts. per lb. | Actual Potash | costs | 3.96 | cts. per lb. |
| " | 1.95 | " | " | " | 3.86 | " |
| " | 1.90 | " | " | " | 3.76 | " |
| " | 1.85 | " | " | " | 3.66 | " |
| " | 1.80 | " | " | " | 3.56 | " |
| " | 1.75 | " | " | " | 3.46 | " |
| " | 1.70 | " | " | " | 3.36 | " |
| " | 1.65 | " | " | " | 3.26 | " |
| " | 1.60 | " | " | " | 3.16 | " |
| " | 1.55 | " | " | " | 3.06 | " |
| " | 1.50 | " | " | " | 2.96 | " |

The Double Sulphate of Potash and Magnesia usually has about 26½ per cent. of actual potash.

| | | | | | | |
|---|---|---|---|---|---|---|
| If quoted at | 1.00 | ct. per lb. | Actual Potash | costs | 3.77 | cts. per lb. |
| " | 1.05 | cts. " | " | " | 3.96 | " |
| " | 1.10 | " | " | " | 4.15 | " |
| " | 1.15 | " | " | " | 4.34 | " |
| " | 1.20 | " | " | " | 4.53 | " |

The following table shows the fluctuations in the wholesale prices of a number of fertilizing materials in the New York market, since April, 1884. The price given for each month is the average of the four weekly quotations in that month. Sulphate of ammonia is assumed to contain 20.5 per cent. and nitrate of soda 15.6 per cent. nitrogen, and muriate of potash 50½ per cent. of actual potash or 80 per cent. of the pure salt.

| | | COST OF NITROGEN AT WHOLESALE IN | | | | COST OF POTASH AT WHOLESALE IN |
|---|---|---|---|---|---|---|
| | | Blood. cts. per lb. | Azotin or Ammonite. cts. per lb. | Nitrate of Soda. cts. per lb. | Sulphate of Ammonia. cts. per lb. | Muriate of Potash. cts. per lb. |
| 1884. | April | 13.6 | 13.6 | 14.0 | 14.6 | 3.38 |
| | May | 14.0 | 13.9 | 14.4 | 15.3 | 3.44 |
| | June | 13.9 | 13.5 | 13.8 | 14.6 | 3.36 |
| | July | 13.2 | 13.5 | 14.2 | 14.9 | 3.37 |
| | August | 13.6 | 13.3 | 14.3 | 14.7 | 3.36 |
| | September | 12.8 | 13.3 | 14.4 | 14.4 | 3.28 |
| | October | 12.9 | 13.2 | 14.3 | 14.8 | 3.38 |
| | November | 12.4 | 12.6 | 14.4 | 15.2 | 3.26 |
| | December | 12.1 | 12.8 | 14.4 | 15.2 | 3.32 |
| 1885. | January | 12.3 | 13.0 | 14.1 | 15.2 | 3.32 |
| | February | 12.6 | 13.4 | 14.4 | 15.2 | 3.36 |
| | March | 13.4 | 13.7 | 13.2 | 15.2 | 3.58 |
| | April | 13.6 | 13.7 | 13.2 | 15.2 | 3.51 |
| | May | 14.3 | 13.7 | 14.1 | 15.2 | 3.54 |
| | June | 13.9 | 13.7 | 14.0 | 15.2 | 3.36 |
| | July | 13.6 | 13.6 | 14.0 | 15.0 | 3.31 |
| | August | 13.8 | 13.6 | 15.0 | 14.9 | 3.34 |
| | September | 13.4 | 13.5 | 15.6 | 14.8 | 3.36 |
| | October | 13.4 | 13.5 | 16.0 | 14.8 | 3.36 |
| | November | 13.8 | 13.5 | 15.6 | 14.8 | 3.38 |
| | December | 14.1 | 13.9 | 16.0 | 14.9 | 3.39 |
| 1886. | January | 14.0 | 14.2 | 15.6 | 15.1 | 3.38 |
| | February | 14.2 | 14.3 | 15.2 | 15.2 | 3.46 |
| | March | 14.9 | 14.7 | 16.0 | 15.8 | 3.64 |
| | April | 14.9 | 15.7 | 16.1 | 16.4 | 3.56 |
| | May | 14.6 | 15.4 | 16.4 | 15.8 | 3.41 |
| | June | 13.9 | 14.7 | 15.6 | 14.6 | 3.32 |
| | July | 14.2 | 14.4 | 14.9 | 14.6 | 3.31 |
| | August | 14.1 | 14.4 | 14.0 | 14.5 | 3.31 |
| | September | 14.1 | 14.4 | 13.7 | 14.4 | 3.40 |
| | October | 14.4 | 14.4 | 13.2 | 14.6 | 3.41 |
| | November | 14.0 | 14.4 | 12.7 | 14.7 | 3.41 |
| | December | 13.3 | 14.5 | 13.1 | 14.7 | 3.41 |
| 1887. | January | 13.3 | 14.5 | 13.0 | 14.6 | 3.41 |
| | February | 13.5 | 14.5 | 13.6 | 14.6 | 3.41 |
| | March | 13.4 | 14.5 | 14.3 | 14.5 | 3.51 |
| | April | 13.6 | 14.1 | 14.9 | 14.5 | 3.56 |
| | May | 13.4 | 14.0 | 14.7 | 14.5 | 3.48 |
| | June | 13.1 | 14.0 | 14.0 | 14.5 | 3.41 |
| | July | 13.1 | 14.0 | 12.0 | 14.5 | 3.41 |
| | August | 12.6 | 13.4 | 11.8 | 14.5 | 3.40 |
| | September | 12.1 | 12.5 | 12.2 | 14.7 | 3.36 |
| | October | 12.1 | 12.3 | 13.0 | 14.9 | 3.36 |
| | November | 11.8 | 12.2 | 12.7 | 14.7 | 3.41 |

### ON THE VALUATION OF TANKAGE.

Tankage has been valued like bone, with due regard to its mechanical as well as its chemical analysis, as explained on page 29, on the assumption that both the fine and coarse particles have the same composition. A possible objection to this method is that the nitrogenous matter of tankage may be much finer than the bone fragments which have been largely freed from their nitrogenous constituents by boiling. If so, then the system undervalues the nitrogen and overvalues phosphoric acid, making the total valuation lower than it should be. To test the matter, two samples of tankage, one of eastern, the other of western manufacture, were separated by sieves into the several grades as practiced in the mechanical analysis of bone, nitrogen and phosphoric acid were separately determined in each portion, and the valuation of each grade was reckoned by the schedule as on page 27. The total valuation thus obtained, free from the objection cited above, could then be compared with the valuation made in the usual way. The results are tabulated on the following page and are so nearly identical as to show that the method of valuation commonly used for bone is equally applicable to tankage.

## ANSWERS TO CORRESPONDENTS CONCERNING FERTILIZERS.

### PREPARATION OF BONE SUPERPHOSPHATE.

In answer to repeated inquiries from various sources, the methods of "dissolving" ground bone, i. e. of preparing a bone superphosphate by help of sulphuric acid—useful where soluble phosphoric acid and nitrogen are desired—is here reproduced from the Report of this Station for 1881.

"Most of the ground bone that comes into market contains a considerable proportion of coarse fragments which may remain in the soil for years before they become of avail to plants. The finest parts of ground bone are, on the other hand, adapted to feed crops at once. If ground bone be treated directly with sulphuric acid, the fine parts are promptly decomposed, but the coarse portions are but little acted on unless a large amount of acid and much time are consumed. Dr. Alexander Müller has proposed the following very rational method of treating ground bone, which is perhaps the best adapted for domestic use of any of the processes involving the use of oil of vitriol.

### TANKAGE.

| | | Mechanical Analyses. | | Chemical Analyses. | | | |
|---|---|---|---|---|---|---|---|
| | | 1889 | 1891 | 1889 | | 1891 | |
| | | Western Tankage. | New York Tankage. | Western Tankage. | | New York Tankage. | |
| | | | | Nitrogen. | Phos. Acid. | Nitrogen. | Phos. Acid. |
| Fine, | smaller than $\frac{1}{50}$ inch | 67 | 73 | 7.04 | 13.01 | 5.54 | 18.74 |
| Fine-medium, | " $\frac{1}{25}$ " | 20 | 13 | 7.90 | 11.19 | 5.57 | 18.04 |
| Medium, | " $\frac{1}{12}$ " | 12 | 10 | 8.22 | 10.56 | 4.05 | 23.54 |
| Coarse-Medium, | " $\frac{1}{6}$ " | 1 | 4 | 9.07 | .... | 2.17 | 31.91 |
| | | 100 | 100 | | | | |

The Valuations per ton were:—

| | 1889<br>Western Tankage. | 1891<br>New York Tankage. |
|---|---|---|
| By the usual method | $38.60 | $41.87 |
| By the special method above described | 38.28 | 41.44 |

Take 100 lbs. of ground bone such as contains 20 to 50 per cent., more or less, of material coarser than ¼ inch, 25 lbs. of oil of vitriol of 66°, the strongest commercial acid, and six quarts of water.

Separate the bone by sifting into two, or if the proportion of coarse bone is large, into three parts, using sieves of $\frac{1}{16}$ inch and ⅛ inch mesh.

Mix the coarser part of the bone in a cast-iron or lead-lined vessel or in the half of an oil barrel with the oil of vitriol. When the bone is thoroughly wet with the strong acid, add the water, stirring and mixing well. The addition of the water to the acid develops a large amount of heat which favors the action. Let stand, with occasional stirring, for twenty-four hours, or until the coarsest fragments of bone are quite soft; then, if three grades of bone are used, work in the next coarser portion of bone, and let stand another day or two until the acid has softened all the coarse bone, or has spent its action; and finally, dry off the mass by mixing well with the finest bone. In carrying out this process, the quantity of oil of vitriol can be varied somewhat—increased a few pounds if the bone has a large proportion of coarse fragments, or diminished if it is fine.

Stöckhardt gives a somewhat different procedure, viz: "From a mixture of sifted wood or coal ashes and earth thrown upon a barn or shed floor, form a circular wall so as to enclose a pit capable of containing one hundred weight of ground bone; the surrounding wall of ashes may be rendered so firm as not to yield by being trodden down or beaten firm with a board.

Sift off the finer part of the bone and set it aside. Throw the coarser part into the cavity, and sprinkle it during continued stirring with three quarts of water until the whole is uniformly moistened; add gradually eleven pounds of oil of vitriol of 66°, the agitation with the shovel being continued. A brisk effervescence of the mass will ensue (from decomposition of the carbonate of lime in the bones), which will not, however, rise above the margin of the pit if the acid is poured on in separate small quantities. After twenty-four hours, sprinkle again with three quarts of water, add the same quantity of sulphuric acid as before, with the same brisk shoveling of the mass, and leave the substances to act for another twenty-four hours upon each other. Then intermix the fine bone previously sifted off, and finally shovel the ashes and earth of the pit into the decomposed bone until they are all uniformly mixed together."

### TREATING BONES WITH ACID.

"Will you inform me if there is any fertilizing property in sulphuric acid or is it only used to cut bone, in the manufacture of superphosphate? I inclose formula for making phosphate that I have taken from my scrap book and ask your opinion of it."

To these questions was replied substantially:

Sulphuric acid is a plant-food but is not generally deficient in our soils. It can be most economically supplied in land plaster which is the sulphate of lime. You ask an opinion as to the inclosed formula. *Fine* bone dust needs no "cutting" with acid to make it readily available for crops. If you do cut it with acid it will usually be necessary to add a drier like the dry loam or wood dirt of your formula, else the mass will be smeary or pasty. If you want a more quickly acting phosphate it would probably be cheaper to buy plain bone-black superphosphate [at $28.00 a ton] and mix one or two hundred pounds to the ton with your bone meal rather than experiment with sulphuric acid which is a somewhat dangerous thing for one unskilled in its use to handle.

The cost of hauling of 1600 pounds of loam from and to the fields will go far towards the purchase of a small proportion of superphosphate.

The best methods of "cutting" bones with sulphuric acid are given on a previous page.

### DISSOLVING BONE, COMPOSTING OFFAL, ETC.

A correspondent inquires in substance as follows:

1. Is the phosphoric acid of steamed bones available?

2. What quantity of acid is it best to use to cut steamed bones?

3. Is it necessary to treat fish with acid in order to make a good fertilizer of them?

4. What is the value of nitrate of potash as a fertilizer?

5. Having refuse meat and offal from a slaughter at my disposal what quantity of muck must I use with it to make compost equal to horse manure and how shall I manage the composting?

### ANSWER.

"1. Doubtless all the phosphoric acid of steamed bone is readily available, not so quickly as that of bones "dissolved" in acid, but quickly enough for all practical purposes, especially if the steaming has been done under high pressure so that the bones are easily crushed to powder.

2. The amount of acid advantageous to use for raw bones you will find stated on page 93 of this Report—Dr. Alexander Müller's method. Steamed bones, if they require acid to subdivide them may be treated in the same manner.

3. It is not needful to treat fish with acid at all in order to make a good fertilizer. To prevent the loss of ammonia, and to suppress stink and destroy flies and maggots it pays to sprinkle the fresh fish-scrap with a few per cent. of diluted oil of vitriol. That makes the bones so friable that they crush easily to powder and mostly converts them into superphosphate.

4. Nitrate of potash is excellent as a fertilizer but costs too much. It is cheaper to use nitrate of soda and muriate of potash together.

5. It is not easy to say how much muck to one of meat will make a compost just equal to horse-manure. I should use muck or leaf mold as dry as possible and use with the meat muck enough to take up the water and leave a nearly dry mass. If needful to make it dry I would add sifted dry coal ashes or wood ashes and I would mix in a good sprinkling of plaster or sulphate of potash. The mixture thus made should be protected from wet and allowed to heat moderately. Then to regulate the heating and prevent loss it should be trodden or stamped down. If that does not suffice, it should be sprinkled with water till moist and packed or stamped more, or the proportion of muck should be increased. These directions are very general but if you will set up several trial heaps, noting carefully what quantities of materials you use and observing that the mixtures should decompose and heat within a reasonable time but should suffer no loss of ammonia [perceptible to the smell] you will soon understand the matter. The Station will assist you by analyses of materials and products on condition that results may be published for the benefit of the public."

## Copperas as a Fertilizer.

A correspondent writes:—

"The Journal of the Chemical Society states that copperas is a valuable dressing for many crops; that one-eighth of an acre with fourteen pounds applied yielded 5278 pounds of potatoes, an increase of 400 pounds over a similar plot not so treated; also recommends it for other crops—hay was doubled in quantity by its use—and so forth.

I would like to ask you what fertilizing material it contains and whether the statement seems reasonable enough to warrant making the experiment. I think it will cost about three cents per pound by the barrel. I expect to use some this year to protect grape-vines from rot and mildew. As it has a sterilizing effect on fungi I should infer that it might act injuriously on the growth of agricultural plants."

Answer.—The statement by A. B. Griffiths in the Journal of the Chemical Society to which you refer gives account of some remarkable results from the use of copperas (protosulphate of iron) on various crops. He found that there was less increase of yield in case of the cereals than with root crops. But he claims that copperas prevents or hinders mildew on wheat and that in very weak solution (one part by weight in one thousand of water), it destroys the spores of mildew; which is remarkable because most spores are very retentive of life. On mossy land Griffiths observed that it destroyed moss and increased the grass crop. All this seems to have been accomplished with very moderate applications, only one-half a cwt. (fifty-six pounds) per acre. Sir J. B. Lawes is quoted as saying that in his experience 1½ cwt. was rather too much to apply per acre. Griffiths' explanation of the favorable effect of copperas is that it increases the chlorophyl in the leaves, of which iron is an essential constituent, and so increases the power of the plant for assimilation. He finds a larger percentage of fiber, of carbhydrates and of nitrogen, in crops raised with an application of copperas than in those produced on the same kind of soil without it, which facts he cites as sustaining his hypothesis. But since the soil itself with which he experimented contained 3·95 per cent. of sesquioxide of iron, it is difficult to believe that it could not furnish as much assimilable iron as his application of fifty-six pounds per acre of copperas. The iron of the soil is, however, in all ordinary cases very slowly and slightly soluble; in some soils a supply of freely soluble iron may be of great advantage to crops. It was demonstrated that the observed increase of crop was not due to a supply of sulphuric acid by the copperas because kainit and superphosphates containing abundance of sulphuric acid, proved to have less effect.

The results are scarcely to be explained by the indirect action of the salt in making plant-food soluble in the soil-water, for kainit, which would be supposed to exert such effect, did not give nearly so large a yield as the copperas. It is probable that in the soil on which Griffiths operated there were certain fungi or bacteria which had an unfavorable effect on crop-production and that copperas was beneficial chiefly or wholly on account of its property of destroying or sterilizing these organisms. Kellner in experiments on small plots of ground in Japan with from 50 to 600 pounds of copperas to the acre found no good effect and no injury from its use. König, in Germany, observed an increase of crop in some trials made in this way.

I know of but one experiment in this country with copperas, made by G. H. Whitcher at the New Hampshire Agricultural College Farm, and reported in "Agricultural Science." To one quarter of an acre of land was applied broad-cast, 70 pounds of dissolved bone black, 30 of muriate of potash and 10 of sulphate of ammonia, and in the hill 35 pounds of dissolved bone black, 15 of muriate of potash and 8 of copperas. To another adjoining quarter-acre plot were added the same fertilizers in the same way but omitting the copperas. Both plots were planted to maize. That which had copperas produced a rank growth of dark green color. The harvest was as follows:

| | Sound Corn. | Soft Corn. | Stover. |
|---|---|---|---|
| One-fourth acre with chemical manures and copperas, | 820 | 110 | 1000 |
| One-fourth acre with chemical manures without copperas, | 670 | 170 | 970 |
| Gain or loss. | + 150 | — 60 | + 30 |

Thirty-two pounds of copperas per acre increased the yield of corn 600 pounds, or 22 per cent.

In Europe many trials with sulphate of iron, sulphate of soda, sulphate of magnesia, common salt, chloride of calcium, chloride of magnesium and various other saline compounds were on record thirty or forty years ago and instances were not wanting in which crops improved in appearance and increased in quantity by such applications.

Trials with copperas being inexpensive, are well worth making, though to judge from past experience this substance will not be found generally helpful. It will be injurious to agricultural plants when applied in too large quantities; even in small quantity it may prove a damage on "sour," that is, close-textured and wet land. It might be found of advantage, if any where, on rich garden land that has had abundance of stable manure applied for many years.

### Superphosphate from Bone.

A correspondent asks:

1. What quantity of acid is necessary to dissolve 100 pounds of bone?

2. What strength of acid is most suitable?

3. What will be the percentage composition of a superphosphate made from bone?

4. What will be the mechanical condition of the superphosphate?

Answer was made as follows:—

1. As to proportion of sulphuric acid to bone. This may properly vary somewhat since commercial "bone" itself is not constant in composition. Its phosphoric acid varies from 19 to 30 per cent. and its nitrogen from 6 to 2·5 per cent., usually the more phosphoric acid, the less nitrogen; and *vice versa*. The age of the bone [or of the animal] the time it has been weathered, boiled or dried, the amount of meat, tendon, marrow and sand adhering to it, all influence its composition.

Some twenty-five years ago Prof. J. T. Way, then chemist to the Royal Agricultural Society of England, stated that 100 pounds of average bone require 29 pounds of strong oil of vitriol [66° acid] to render the phosphoric acid all soluble, but as the organic tissue of the bone absorbs the sulphuric acid, sponge fashion, some excess of oil of vitriol, 35 to 40 pounds per 100 of bone, must be used for complete conversion of the phosphoric acid into a form soluble in water.

2. The strength of sulphuric acid to be used.

If oil of vitriol of 66° be used, it should be diluted with about one-half its weight of water. A corresponding quantity of "chamber acid" may be used.

3. Way states that 100 pounds of bone and 29 pounds of 66° acid should give a product of which 100 pounds contain,

| | | |
|---|---|---|
| Water | 10 | |
| Animal matter | 27 | with 1·25 nitrogen. |
| Hydrated sulphate of lime | 39 | |
| Superphosphate of lime | 24 | with 17 soluble phosphoric acid. |

In practice, however, all the phosphoric acid is not made soluble.

4. Pure bone-superphosphate will be an unmanageable paste if enough sulphuric acid be used to make nearly all its phosphoric acid soluble. There is agriculturally no gain in making all the phosphoric acid of bones soluble in water. Fine bone is of itself a quick fertilizer requiring no treatment with oil of vitriol, so that the most economical result is attained by acting on the coarser parts of ground bone with sulphuric acid, and using the fine bone as a dryer.

An account of the method of dissolving bone is given on page 93.

## VALUE OF WASTE LYE FROM SOAP WORKS.

To an inquiry on this subject, referred to the Station, reply was made as follows, after obtaining and analyzing a sample.

The analysis of the waste lye is as follows :—

| | |
|---|---|
| Nitrogen | ·04 |
| Potash | ·03 |
| Soda | 5·34 |
| Water | 88·79 |
| Carbonic Acid, with small amounts of Chlorine, Sulphuric Acid and undetermined matters, by difference | 5·80 |
| | 100·00 |

The analysis fully confirms the view that the waste of soap works is now-a-days essentially destitute of plant-food. This sample contains soda corresponding to 12·3 per cent. of sodium carbonate. Since in the analysis, soda and carbonic acid, etc., amount to but 11·1 per cent. there is evidently a small amount of caustic soda remaining in the lye. Speaking in general terms, carbonate of soda cannot be recommended as an application to land. There are indeed cases where it may do good, as experience has shown. Soil that is rich in vegetable matter, either that of drained swamp-land, or of fields and gardens that have been heavily dressed with stable manure, may be benefited and are least likely to be harmed, by its use. Its action on such soils is indirectly to feed the crops by favoring the conversion of the inert nitrogen of the vegetable matter into soluble and available forms. If applied directly to the land, the lye should be diluted with 10 to 20 times its bulk of water. The best use to make of this lye would be in composting and rotting swamp-muck or coarse vegetable refuse.

## ANALYSES OF FEEDING STUFFS.

In former reports extended explanations concerning the Analysis, Valuation and Economical Use of Feeding Stuffs have been given. It is not thought necessary to repeat them here since copies of Reports containing them can be supplied to any who desire such explanations.

Twenty-two Samples of Feeding Stuffs* have been analyzed during the year 1887. Those which have general interest are here noticed.

### HAY.

CCXLVIII. Rather coarse Clover Hay, baled. Bought in New Haven.

CCXLIX. Hay from mixed grasses, chiefly blue-grass (*Poa pratensis*) and fine bent (*Agrostis vulgaris*), cut on the Station land early when the blue-grass was in bloom.

ANALYSES.

| | Baled Clover Hay. CCXLVIII. | Hay of Mixed Grasses. CCXLIX. |
|---|---|---|
| Water | 15.11 | 20.25 |
| Ash | 3.17 | 4.68 |
| Albuminoids | 6.44 | 9.21 |
| Fiber | 29.77 | 22.92 |
| Nitrogen-free Extract | 4373 | 40.58 |
| Fat (Ether Extract) | 1.78 | 2.36 |
| | 100.00 | 100.00 |

### SOME CONNECTICUT GRASSES.

In regard to these grasses Mr. J. B. Olcott of South Manchester kindly furnishes the following notes:

"The grasses whose analyses follow, with the exception of *Sorghum halapense*, Johnson grass,† are native grasses, growing with and without cultivation in our most productive meadows, as well as in neglected places, since the first settlement of the country. Farm testimony is abundant, but varying as to their value. Except that the foliage of several is injured by autumn frosts, their hardiness is unquestioned and even made a demerit by those who do not value *very* permanent meadow, wherein these deep-rooted and lasting grasses distinguish themselves. *Andropogon provincialis* (forked Andropogon, blue-stem of the west), has many strong friends, and this together with *Panicum virgatum* (black-bent), and *Chrysopogon nutans* (broad bent), must be considered worthy of close attention by investors in really permanent forage. Their seeding qualities and other practical points are not well known and cannot be ascertained in a single year's study. In the famous 'Hartford Meadows,' including the Windsors and Glastonbury, these, with other tall grasses in varying proportions, covering a finer growth of *Poa pratensis*, exist in park-like expanses of hundreds of acres, offering conclusive testimony of their worth to the State, and tempting investigation as to their more general value and uses.

---

* Exclusive of potatoes.

† And perhaps of *Festuca ovina.*

*Glyceria nervata* prefers wet land (as the before-mentioned grasses do not), and makes seed freely. Of the lesser *Andropogons*, *scoparius*, prominent on Wallingford plains, is far better than bushes for forage. *Virginicus* is less prevalent than the other and less frequent in very dry land."

CCLXIII, *Glyceria nervata*, nerved meadow grass, cut in bloom in a wet spot by the road side in New Haven.

CCLXV, *Festuca ovina* (?), sheep's fescue, cut in bloom under evergreen trees in a door yard in New Haven.

CCLXVI, *Panicum virgatum*, black-bent.

CCLXVII, *Andropogon provincialis*, blue-bent.

CCLXVIII, *Chrysopogon nutans*.

The last three samples were cut Sept. 9, in East Hartford meadows and brought to the station the same day by Mr. J. B. Olcott, who used all care that they should not dry out before their arrival. They represent rowen headed, but cut before bloom.

CCLXIX, *Andropogon scoparius*, broom grass, and

CCLXX, *Andropogon Virginicus;* both cut by Mr. Olcott on his own land, Sept. 9, 1887, in condition like his other specimens but from poorer land owing to the vicinity of trees.

CCLXXI, *Panicum crus-galli var. hispidum*, barn yard grass. This was raised from seed—gathered the year before from a dumping ground in New Haven—planted in the Station Forage Garden. The seed was drilled in, Sept. 25, 1886, and did not come up that fall. The drill was replanted March 21, 1887. May 15 it came up, apparently from both fall and spring planting. Being a hot-weather grass it did not make great progress till July when it grew rapidly and stood five feet high and over, Sept. 5, when this sample was cut for analysis. The seed had formed but was not ripe. The seed was ready to gather the last week in Sept. The stalks at that time were greedily eaten clean by cows. This grass seems to be a surface feeder and filled the soil so completely with fine fibers that a hoe could scarcely be worked within a foot of the stalks. The seed of this grass is common enough in untidy potato fields in the fall and springing the next year is frequently cut for hay. Its qualities to be considered for that use are, quick and rank growth during July and August, besides being shallow-rooted and an annual and hence not troublesome in the following season if cut before seeding. It dries slowly and we do not recommend it for general use but regard it worthy of further trials here.

CCLXXVII, *Panicum agrostoides*, red top panic, cut at same place and time as CCLXX; common in the wetter portions of Hartford meadows.

CCLXXVIII, *Sorghum halapense*, Johnson grass. Cut in the Station Forage Garden, Sept. 5, 1887. The seeds had formed but were not ripe. This grass grew very thriftily but rusted badly about the time of blossoming. Sown in the late summer it is completely winter-killed and probably cannot survive the winter in this latitude.

As a standard of comparison the following table includes analyses of the dry substance of timothy hay—average of 53 analyses and of good meadow hay from mixed meadow grasses—average of 9 analyses.

A single analysis does not settle the value of a forage plant. Differences of soil, climate and season have a great effect on the chemical composition and feeding value of forage but these analyses are here given as a single contribution to our knowledge of their composition.

## ANALYSES OF GRASSES.

*Freshly Cut.*

| | Glyceria nervata. | Festuca ovina (?) | Panicum virgatum. | Andropogon provincialis. | Chrysopogon nutans. | Andropogon scoparius. | Andropogon Virginicus. | Panicum crus-galli var. hispidum. | Panicum agrostoides. | Sorghum halapense. | Timothy Hay. | Hay from mixed meadow grasses. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CCLXIII. | CCLXV. | CCLXVI. | CCLXVII. | CCLXVIII. | CCLXIX. | CCLXX. | CCLXXI. | CCLXXVII. | CCLXXVIII | 53 analyses | 9 analyses. |
| Water | 74.88 | 71.85 | 65.16 | 73.09 | 67.01 | 57.08 | 64.50 | 80.52 | 65.01 | 68.62 | ---- | ---- |
| Ash † | 1.83 | 1.85 | 1.94 | 1.58 | 2.86 | 1.72 | 1.24 | 1.43 | 3.55 | 1.74 | ---- | ---- |
| Albuminoids * | 2.64 | 2.91 | 3.67 | 2.15 | 2.42 | 1.74 | 2.20 | 1.42 | 2.42 | 2.89 | ---- | ---- |
| Fiber | 8.41 | 9.98 | 10.40 | 8.51 | 9.96 | 16.21 | 13.03 | 6.75 | 10.44 | 9.37 | ---- | ---- |
| Nitrogen-free Extract | 11.75 | 12.68 | 17.99 | 14.05 | 17.00 | 22.64 | 18.30 | 9.54 | 17.93 | 16.44 | ---- | ---- |
| Fat | .49 | .73 | .84 | .62 | .75 | .61 | .73 | .34 | .65 | .94 | ---- | ---- |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | ---- | ---- |
| Nitrogen | .42 | .46 | .58 | .34 | .38 | .28 | .35 | .23 | .38 | .46 | ---- | ---- |
| Phosphoric Acid | ---- | ---- | .15 | .09 | .19 | .13 | .13 | .09 | ---- | ---- | ---- | ---- |
| Potash | ---- | ---- | .20 | .18 | .36 | .29 | .28 | .47 | ---- | ---- | ---- | ---- |

*Water-free.*

| | Glyceria nervata. | Festuca ovina (?) | Panicum virgatum. | Andropogon provincialis. | Chrysopogon nutans. | Andropogon scoparius. | Andropogon Virginicus. | Panicum crus-galli var. hispidum. | Panicum agrostoides. | Sorghum halapense. | Timothy Hay. | Hay from mixed meadow grasses. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ash† | 7.29 | 6.57 | 5.57 | 5.87 | 8.67 | 4.01 | 3.49 | 7.34 | 10.14 | 5.54 | **4.58‡** | **5.57‡** |
| Albuminoids * | 10.39 | 10.25 | 10.53 | 8.18 | 7.35 | 4.06 | 6.21 | 7.32 | 6.94 | 9.20 | **6.74** | **7.38** |
| Fiber | 33.53 | 35.46 | 29.84 | 31.50 | 30.35 | 37.75 | 36.66 | 34.65 | 29.83 | 29.87 | **33.82** | **36.79** |
| Nitrogen-free Extract | 46.83 | 45.15 | 51.64 | 52.16 | 51.34 | 52.74 | 51.57 | 48.94 | 51.24 | 52.41 | **52.50** | **47.85** |
| Fat | 1.96 | 2.57 | 2.42 | 2.29 | 2.29 | 1.44 | 2.07 | 1.75 | 1.85 | 2.98 | **2.36** | **2.41** |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | **100.00** | **100.00** |
| Nitrogen | 1.68 | 1.63 | 1.67 | 1.26 | 1.15 | .65 | .98 | 1.18 | 1.11 | 1.47 | ---- | ---- |
| Phosphoric Acid | ---- | ---- | .43 | .34 | .57 | .30 | .37 | .46 | ---- | ---- | ---- | ---- |
| Potash | ---- | ---- | .57 | .67 | 1.09 | .68 | .79 | 2.41 | ---- | ---- | ---- | ---- |

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* The total nitrogen is here reckoned as albuminoids, by multiplying it by 6¼. On p. 104 it will be seen that in eight of the samples but from 68 to 88 per cent. of the nitrogen probably existed in the form of albuminoids, 12 to 32 per cent. occurring, for the most part, doubtless, in the state of "amides."

† Free from carbonic acid, water, and char.

‡ Probably crude ash.

As a further contribution to the knowledge of these grasses the mineral matter in them, "Ash," of the previous table, has been analyzed by Dr. Osborne. The results are as follows:*

### COMPOSITION OF THE ASH OF GRASSES.

| | Panicum virgatum. CCLXVI. | Andropogon provincialis. CCLXVII, | Chrysopogon nutans. CCLXVIII. | Andropogon scoparius. CCLXIX. | Andropogon Virginicus. CCLXX. | Panicum crus-galli, var. hispidum. CCLXXI. |
|---|---|---|---|---|---|---|
| Potash | 10.53 | 11.13 | 12.29 | 17.01 | 23.61 | 33·47 |
| Soda | 1.99 | .73 | .87 | .57 | 1.01 | 2.35 |
| Lime | 11.09 | 9.91 | 5.65 | 7.65 | 6.00 | 8·49 |
| Magnesia | 10.31 | 7.38 | 4.13 | 5.75 | 7.49 | 11.29 |
| Oxide of Iron | .35 | .25 | .12 | .46 | .39 | .85 |
| Sulphuric Acid | 4.74 | 2.66 | 1.28 | 2.51 | 2.64 | 11.48 |
| Phosphoric Acid | 7.62 | 5.55 | 6.35 | 7.82 | 11.23 | 6.53 |
| Chlorine | .55 | .78 | .72 | 2.40 | 3.34 | 1.26 |
| Silica and adher'g Sand | 52.94 | 61.77 | 68.75 | 56.37 | 45.04 | 24.56 |
| | 100.12 | 100.17 | 100.16 | 100.54 | 100.75 | 100.28 |
| Deduct Oxygen equivalent to Chlorine | .12 | .17 | .16 | .54 | .75 | .28 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

The "albuminoid" nitrogen, determined by Stutzer's method (Jour. für Landwirthschaft, 1881, p. 476. Report of this Station for 1885, p. 40), was as follows, in the air-dry substance.

| | Panicum virgatum. CCLXVI. | Andropogon provincialis. CCLXVII. | Chrysopogon nutans. CCLXVIII. | Andropogon scoparius. CCLXIX. | Andropogon Virginicus. CCLXX. | Panicum crus-galli. CCLXXI. | Panicum agrostoides. CCLXXVII. | Sorghum halapense. CCLXXVIII. |
|---|---|---|---|---|---|---|---|---|
| Total Nitrogen | 1.53 | 1.17 | 1.08 | .77 | .91 | 1.10 | 1.02 | 1.35 |
| "Albuminoid" Nitrogen | 1.16 | .87 | .87 | .60 | .71 | .75 | .87 | 1.19 |
| Per cent. of "Albuminoid" Nitrogen (Total Nitrogen=100.) | 75.8 | 74.3 | 80.6 | 77.9 | 78.0 | 68.2 | 85.3 | 88.1 |

### CONCENTRATED FOODS.

CCL. Beans. These were bought of a seedsman, being old stock and worthless for seed, but good feed for sheep.

CCLIX. Chicago gluten meal. Sold by Holmes and Keeler,

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* The analyses were made on the crude ash which contained some carbon. This was determined by drying silica and carbon together at 100° C., weighing and then igniting. Operating in this way the mixture of carbon and silica cannot be perfectly dried and for that reason the analyses came somewhat high, about 101 per cent. They are here reckoned free from carbonic acid, water and carbon.

Norwalk. Cost $21.00 per ton. Sent by D. H. Van Hoosear, Wilton.

DCLXII. "Corn-Germ Feed" from an Indianapolis Hominy Mill. Cost about $1.00 per 100 lbs. Sent by F. W. Holmes, Salisbury.

CCLX. Spring Wheat Bran and CCLXI. Winter Wheat Bran. Sent by S. D. Newell, Bristol.

ANALYSES.

| | Beans. CCL. | Gluten Meal. CCLIX. | Corn Germ Feed. CCLXII. | Spring Wheat Bran. CCLX. | Winter Wheat Bran. CCLXI. |
|---|---|---|---|---|---|
| Water | 15.00 | 8.23 | 12.18 | 10.90 | 11.13 |
| Ash | 3.10 | 1.27 | 2.54 | | |
| Albuminoids | 20.37 | 27.38 | 10.87 | 15.19 | 14.06 |
| Fiber | 3.20 | 1.46 | 8.30 | | |
| Nitrogen-free extract | 56.71 | 55.98 | 56.87 | | |
| Fat | 1.62 | 5.68 | 9.24 | 4.85 | 4.47 |
| | 100.00 | 100.00 | 100.00 | | |

Analyses of maize kernel and cob and of maize stalks will be found on pages 119 and 120 in the discussion of a field experiment and they need not be repeated here.

## "IMPERIAL GRANUM."

CCLXXIX. as described by the proprietor, "Imperial Granum, The Great Medicinal Food. This justly celebrated dietetic preparation is in composition principally the gluten derived by chemical process from very superior growths of wheat. A solid extract. The invention of an eminent French chemist. It has acquired the reputation of being an incomparable aliment for the growth and protection of infants and children. The salvator for invalids and the aged," etc., etc.

ANALYSIS.

| | Imperial Granum. | Wheat flour Average of 25 analyses. |
|---|---|---|
| Water | 11.10 | 12.56 |
| Ash | .33 | .56 |
| Albuminoids, including "gluten" | 10.13 | 11.28 |
| Fiber | .10 | .27 |
| Nitrogen-free extract | 77.58 | 74.13 |
| Fat | .82 | 1.20 |
| | 100.00 | 100.00 |
| Cost per pound | $1.00. | $0.025—0.05 |

The "Imperial Granum" contains 77.24 per cent. of wheat-starch with possibly some dextrin. The quantity of dextrin and dextrose is not more than 1.8 per cent. The only wide difference between the figures given above for "Granum" and wheat flour is in the *cost per pound.* The "Granum" cannot be distinguished in chemical composition and properties from wheat flour slightly browned, which cooked as a porridge has long been used and prized as a food for infants and invalids.

It does not consist principally of the gluten of wheat, and is in no respect superior as food to good wheat flour.

### "ANTI-FERMENTINE."

CCXLV. Made by W. W. Chase, Newburgh, N. Y. Sent by C. E. Sperry, Bolton. It is described by the manufacturer as follows: "Anti-fermentine is a simple, harmless preparation, free from taste, smell and color that has the property of stopping and preventing fermentation. * * * It is especially useful for preserving fruits of all kinds without cooking, retaining the natural fresh appearance and taste of the fruit. The question is sometimes asked: Is it injurious? To allay all doubts on that score we would say that we have consulted many of our most eminent chemists and physicians, and all unite in pronouncing the use of Anti-fermentine as a preservative a perfectly safe and harmless preparation, being composed of pure table salt and salicylic acid."

The composition of the article was as follows:—

| | | | |
|---|---|---|---|
| Chlorine | 19.87 | | |
| Equivalent salt | | 32.75 | per cent. |
| Nitric acid | 18.59 | | |
| Equivalent saltpeter | | 34.80 | " |
| Salicylic acid (by difference) | | 32.45 | " |
| | | 100.00 | |

The mixture consists accordingly of about equal weights of saltpeter, salt and salicylic acid. A single package contains about 50 grams or less than 2 ounces and costs 60 cents.

### POTATOES.

A number of analyses of potatoes have been made at the request of Mr. Theron E. Platt of Newtown, who has made a specialty of growing potatoes and testing new varieties. The analyses with a single exception were made on samples kindly supplied by Mr. Platt. For table of analyses see page 108.

CCLXI. Home Comfort. First quality.

A. Variety unknown. Bought in New Haven.

CCXLVI. White Flower. Raised with 200 pounds sulphate of potash to the acre.

CCXLVII. White Flower. Raised with 200 pounds muriate of potash to the acre.

CCLXII. Early Telephone. First quality.

CCLX. Rosy Morn. First quality.

CCLXIII. Queen of the Valley. Second quality.

CCLIX. White Star. Second quality.

### *Methods of Analysis.*

*Specific gravity* was determined by weighing the potatoes and also the water which they displaced when put into a jar previously filled with water.

*Water.* The potatoes after weighing were cut into thin slices, partly dried, ground and again weighed. A portion was further pulverized so as to pass through fine bolting cloth and on this material all subsequent determinations were made. Water was determined by drying at 120° C. in a stream of dry hydrogen.

*Starch* was determined by Sachsse's method with separation of cellulose, as described on page 132.

*Total Nitrogen*, by Kjeldahl's method.

*Albuminoid Nitrogen* was determined by Stutzer's method (Jour. für Landwirthschaft 1881, p. 476. Report of this Station for 1885, p. 40).

*Amide Nitrogen*, more properly nitrogen of the amides and amido-acids, asparagine etc.—was determined by Sachsse's method (Versuchs-St. XVI. p. 61.)

## Analyses of Potatoes.

| Station No. | Variety. | Specific Gravity. | Water. | Starch. | Ash. | Other matters, by difference. | Nitrogen. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Total. | Albumin-oid. | Amide. | In other forms. |
| CCLXI | Home Comfort, 1st quality........ | 1.099 | 75.58 | 19.39 | 1.09 | 3.94 | .24 | .17 | .04 | .03 |
| (A) | From New Haven market ........ | 1.099 | 76.23 | 19.06 | --- | .... | .37 | -- | -- | -- |
| CCXLVI | White Flower, with sulphate..... | 1.091 | 76.77 | 18.38 | .93 | 3.92 | .38 | .21 | .10 | .07 |
| CCLXVII | White Flower, with muriate ...... | 1.082 | 77.39 | 17.99 | .98 | 3.64 | .35 | .19 | .08 | .18 |
| CCLXII | Early Telephone, 1st quality ...... | 1.087 | 78.08 | 17.17 | .96 | 3.79 | .39 | .21 | .09 | .09 |
| CCLX | Rosy Morn, 1st quality........... | 1.082 | 79.25 | 16.53 | .85 | 3.37 | .32 | .18 | .07 | .07 |
| CCLXIII | Queen of the Valley, 2d quality .. | 1.072 | 79.86 | 15.69 | .84 | 3.61 | .39 | .23 | .09 | .07 |
| CCLIX | White Star, 2d quality ........... | 1.076 | 80.99 | 14.50 | 1.13 | 4.38 | .32 | .16 | .08 | .08 |

The following percentage statement gives a better idea of the relative quantities of the different forms of nitrogenous matter in these potatoes than the table of analyses presents.

| VARIETY. | Per cent. of the Total Nitrogen present in | | |
|---|---|---|---|
| | Albuminoids. | Amides. | Other forms. |
| Home Comfort | 71.2 | 17.6 | 11.2 |
| White Flower (sulphate) | 55.5 | 27.4 | 17.1 |
| White Flower (muriate) | 54.5 | 23.8 | 21.7 |
| Early Telephone | 53.5 | 23.3 | 23.2 |
| Rosy Morn | 54.0 | 21.6 | 24.4 |
| Queen of the Valley | 59.2 | 23.5 | 17.3 |
| White Star | 51.9 | 23.3 | 18.8 |

## CORRESPONDENCE RELATING TO FEEDING STUFFS.

### *Fern and Bog Hay.*

Referring to an analysis of the buckhorn fern, *Osmunda regalis*, published in our last report, Joshua Lyon, Esq., of Greenwich, writes as follows:

"In the report of the Experiment Station just received I read: 'As far as chemical analysis can indicate, the fern is equal to good meadow hay in composition; but it should be remembered that chemical analysis alone does not positively determine the feeding value.' My experience in regard to its feeding value, not from a scientific point of view but from actual results, is as follows. I have two pieces of ground, one upland, the other lowland. The upland hay consisted of timothy, red-top, etc., and was cut in good season about the 10th of July, and got in in good condition. The swamp hay was cut in the middle of August and a portion of it got wet. It consisted of ferns, bog hay, red-top and some willows [which last the cows did not eat however]. The yield of milk from 18 cows on the good hay was about 160 quarts per day while from the bog hay, fern, etc., it was about 180 quarts per day. The other feed, bran 4 pounds, meal 6 pounds per day was the same in both cases."

### *Undecorticated Cotton Seed Meal as a Cattle Food.*

A sample of this article sent to the Station with the inquiry whether it was sufficiently decorticated to be a safe food, was submitted to Mr. J. J. Webb of Hamden and after receiving his opinion the following answer was sent:—

"The cotton seed meal received from you was submitted to Mr. Webb who has had considerable experience in feeding cotton seed meal to milk cows. He says in regard to it, 'I can see no reason on account of its not being thoroughly decorticated why it should not be a safe food. I fed undecorticated meal for some three winters and discovered no ill effects from it on my cows. Since then I have fed thoroughly decorticated meal and abortions taking place, I was led to suspect that the cotton seed meal was the cause.' It is a fact that many English stock-feeders prefer the undecorticated to the decorticated meal, and claim it is far less likely to cloy the cattle. This may be due to the fact that undecorticated meal is a less concentrated feed than the other or there may be something in the hulls which either medicinally or mechanically helps the digestion."

## FIELD EXPERIMENT WITH PHOSPHATES.

Last spring it was proposed to make field experiments to test the relative value of certain phosphates for the corn crop. The land owned by the Station is unsuitable for this purpose because phosphates do not sensibly increase its productiveness, as has been demonstrated by four years' experience. Some years ago Mr. Charles Fairchild of Middletown and Mr. W. I. Bartholomew of Putnam, both proved by a series of field experiments, proposed by Prof. Atwater of Wesleyan University and carried out by them with great skill and care, that their land was strikingly benefited by phosphates; and on this account each of these gentlemen was asked to undertake for the Station the care of an experiment. Mr. Fairchild assented at once and the details of the plan were being arranged when they were interrupted by his sudden death—which was a serious loss to the farming interest of this State.

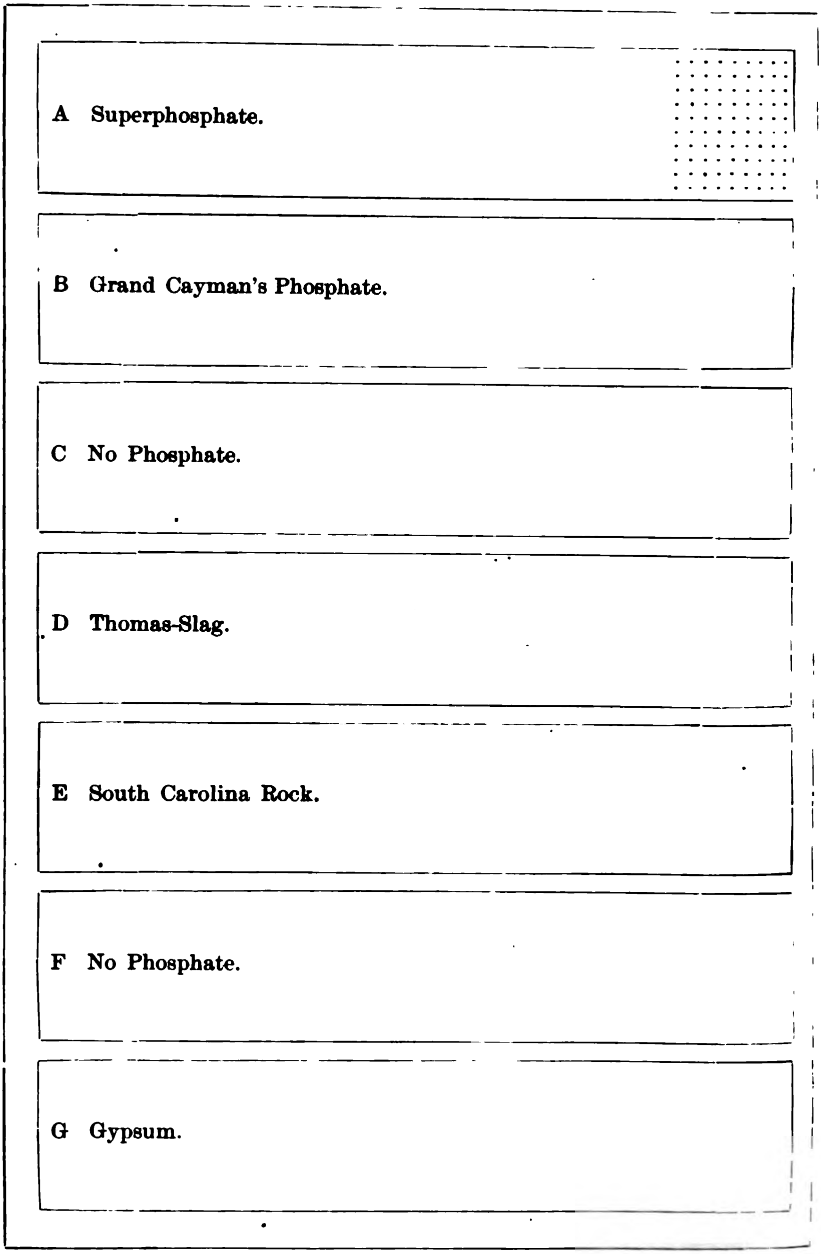
Our first letter to Mr. Bartholomew was lost in the mail which occasioned delay, but having finally secured his coöperation the Station was able to get the fertilizers delivered in time for planting on the 24th of May.

The land used for the experiment was high, gently sloping to the southwest. The soil was a dark loam, moist, with clayey sub-soil. The fall before, it had been sown to rye which was badly winter-killed. Though land in the same field had not been helped in past years by potash salts or nitrogenous manures, it was thought best to use them on the experimental plots to make sure that both available nitrogen and potash should be present in excess of the needs of the crop and that available phosphoric acid should be relatively deficient; in other words so that the total yield would be limited by the quantity of available phosphoric acid in the soil and not by the nitrogen or potash. Accordingly after plowing there were broadcast 200 pounds of muriate of potash and 100 pounds of sulphate of ammonia per acre. The land was then well pulverized with a Thomas smoothing harrow and laid out for the experiment. It was divided into seven plots each 10 rods long and 2 rods wide, or one-eighth of an acre in area. They are distinguished as A, B, C, etc. A plan of the field and more particular description is given on the following page.

The phosphates chosen for comparison were: 1. Dissolved Bone Black, containing 15.83 per cent. of phosphoric-acid; 2. A finely pulverized phosphatic rock, from Grand Cayman Island in the Caribbean Sea, containing considerable iron and alumina with 29.49 per cent. of phosphoric acid, placed at our disposal by N. B. Powter, Esq., 181 Pearl street, N. Y.; 3. Thomas-Slag, a bye-product of the steel manufacture, furnished by Paul Weidinger, Esq., No. 76 Pine street, N. Y., and containing 19.5 per cent. of phosphoric acid. (See page 31); 4. Ground South Carolina Rock, containing about 25 per cent. of phosphoric acid. These phosphates it is well known differ widely in the solubility and presumably also in the availability of their phosphoric acid. It is a practical question however whether their prices stand in direct relation to their agricultural value; whether for some crops it may not pay to use, instead of a small quantity of superphosphate a larger quantity of some other and less soluble phosphate at a lower price. The different phosphates were applied therefore in such quantity as to make the *cost price* in each case approximately the same.

It was necessary first to fix on an application of superphosphate which should insure a fair yield and yet should not be in excess of the requirements of a full crop but rather slightly deficient.

The reason is obvious. Suppose that the land is relatively deficient in phosphates and therefore able to yield but 25 bushels per acre. Suppose also that addition of $3.00 worth of soluble phosphoric acid (superphosphate) would remedy the deficiency



The plots are 2 rods wide and 10 rods long and contain one-eighth of an acre each. The hills of corn are one-fifth of a rod apart each way and the outside hills are one-tenth of a rod from the edge of the plot. Between the plots are spaces one-fifth of a rod wide and in the middle of each space is a single row of potatoes. The whole ground under experiment is surrounded by a double row of potatoes.

and make the crop 50 bushels. Now if $2.50 worth of soluble phosphoric acid is added, this will nearly but not fully meet the requirements of the crop, giving a yield of perhaps 45 bushels and if various phosphates be compared together, those nearly or fully able to feed the crop, will show an increased yield, up to 50 bushels.

If on the other hand $3.50 worth of superphosphate were used, the yield would still be 50 bushels, while other phosphates, though able to feed a larger crop, and more economical, could not show a better effect. Neglect to sufficiently regard this point often leads to quite false conclusions from the results of field experiments.

Experiments made by Mr. Bartholomew in past years* with 51, 25½ and 17 pounds of phosphoric acid per acre on land in the same field, had yielded 2900 pounds, 2650 pounds, and 2330 pounds of sound field-cured ears respectively. It was fair to suppose then that 40 pounds of phosphoric acid especially in connection with a full supply of potash and nitrogen would not be in excess of the needs of the crop. Therefore this quantity was taken as the standard and a quantity of superphosphate was used on one-eighth of an acre plot which would furnish one-eighth of 40 or 5 pounds of phosphoric acid. The plots were arranged as follows:

| | | | | Costing | Containing Phosphoric acid. | Ton price. |
|---|---|---|---|---|---|---|
| Plot A | had | 32 lbs. | Dissolved Bone Black, | 42 cts. | 5.1 lbs. | $26.00 |
| " B | " | 56 " | Grand Cayman's Phosphate, | " | 16.5 " | 15.00† |
| " C | " | | No phosphate. | | | |
| " D | " | 67¼ " | Thomas-Slag, | " | 13.2 " | 12.50† |
| " E | " | 70 " | Ground So. Carolina Rock, | " | 17.5 " | 12.00 |
| " F | " | | No phosphate. | | | |
| " G | " | 16.9 " | Gypsum. | | | |

Contiguous to these plots there was another, H, which received the same quantities of nitrogen and potash as A, but twice as much superphosphate. Another plot was measured off at harvest in Mr. Bartholomew's large field, containing one-eighth of an acre and 500 hills. This land was inverted sod and had received 15 loads of stable manure to the acre and bone dust in the hill besides. It was selected because it appeared to be the heaviest corn in the field. This was called plot X.

It was designed that Plots C and F with no phosphates should show the natural capacity of the land to supply phosphoric acid to the crop. To Plot G was applied a quantity of plaster containing as much sulphuric acid as existed in the superphosphate on Plot A. All the fertilizers were carefully weighed out and bagged at the Station and shipped by freight to Mr. Bartholomew. The phosphates were applied in the hill and the corn was planted on May 24th. The week following, after a gentle rain, dried blood was broadcast at the rate of 100 pounds per acre. It had been delayed on the road and did not come in time to be spread with the other fertilizers. The corn was planted in hills about 3 feet and 3 inches apart each way, making 10 rows or 500 hills in each plot. The seed was Rhode Island White Cap, a flint corn with small ears eight rowed and plump. Two ears on a stalk are rare. It came up well and was thinned at hoeing time to five stalks to a hill. One month after planting the stand on Plot A was decidedly taller and heavier than on the other plots which appeared nearly uniform in these respects. On the 10th of August the following notes were made by Dr. Jenkins who then examined the field.

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* Report of Connecticut Board of Agriculture, 1877, pages 357 and 358.

† f. o. b. New York.

"Plot A looks nearly as well as other parts of the field which have had 15 loads of stable manure to the acre and bone dust in the hill. It is decidedly the best of the plots in appearance. The corn is more mature, all the anthers have fallen and some tassels are already crisp. The tassels are well developed, having 8–15 side branches.

B and D look about alike. Not as large stalks as A. Anthers still hanging, and tassels not as large as on A.

C is very poor. The corn is not as tall as on those just named, the silk is green, pollen not all fallen, and tassels very imperfectly developed, consisting of a single upright stalk and only one, two or three side branches.

E looks rather better than C and F but not as well as the rest.

G looks perhaps a little better than C and F. There have lately been very severe rains which washed and somewhat gullied the field which slopes gently from A to G, and G *may* have been benefited by this wash, though I doubt it. The whole piece is very accurately laid out, the hills are regular, each of five stalks, very few defective hills."

The year was rather more than commonly good for raising corn, through August and early September particularly, and plots B and D improved very much in appearance. The corn was cut and stacked on the 20th of September and on the 13th and 14th of October it was husked by Mr. Bartholomew's workmen and weighed by Dr. Jenkins.

A weighed portion of the corn on the cob was taken to the Station in order to determine the relation of kernel to cob as well as the dry weight of each. The weights of the field-cured crop are as follows :

WEIGHTS IN POUNDS OF THE FIELD-CURED CROPS.

| Plot. | SOUND CORN ON THE COB. | SOFT, IMMATURE CORN ON THE COB. | CORN STALKS, LEAVES & HUSKS. | TOTAL WEIGHT. |
|---|---|---|---|---|
| A, Superphosphate ...... | 479 | 108 | 472 | 1059 |
| B, Grand Cayman's ...... | 469 | 102 | 559 | 1130 |
| C, No Phosphate ....... | 319½ | 178 | 465½ | 963 |
| D, Thomas-Slag .......... | 463½ | 90½ | 494 | 1048 |
| E, So. Carolina Rock .... | 394 | 105½ | 459½ | 959 |
| F, No Phosphate ........ | 343½ | 140 | 459½ | 943 |
| G, Plaster .............. | 376 | 113 | 456 | 945 |
| H, Superphosphate, double quantity .......... | ---- | ---- | ---- | 1045½ |
| X, .................... | 462 | 65 | 545 | 1072 |

In examining the results it will be noticed :

1st. A fair yield was got on the plots A, B, D, H and X, which had received applications of phosphates. The highest yield, on Plot A, is 479 pounds of sound corn on the cob, or 3832 pounds per acre. Allowing one-sixth for cob,* we have 3194 lbs. of shelled corn, or 57 bushels per acre of field-cured corn, if we reckon 56 pounds to the bushel. Field-cured corn, however, will weigh more than 56 pounds per bushel. From the number of baskets of ears at harvest Mr. Bartholomew reckoned the yield at from 45 to 50 bushels of shelled corn per acre.

2d. It also appears that the land was suited to the experiment because in each case the crop was notably increased by the use of phosphate.

3d. Before comparing the effects of the different phosphates it is necessary to inquire whether on Plot A phosphoric acid was applied in excess of the requirements of the crop,—whether there was more phosphoric acid in the soil than the crop could use. If so, then a close comparison cannot be made between the superphosphate and the other phosphates.

It is seen that the total yield on plot H, with a double quantity of superphosphate, is 1045½ pounds, rather less than on plots

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* The quantity found by actual trial.

A, B and D. The weight of sound corn on X also is rather less than on plots A, B and D, and the total weight of crop is less than on B. It seems clear then, that the yield on A was about all that could be got out of the land this year, and with this variety of seed, and that the quantity of superphosphate was either sufficient for the crop production or was in excess of it.

It should be said that the corn at harvest time *looked* a little heavier and ranker on plot X than on A, and that A *looked* better than B or D, but this appearance was not borne out by the weighing. The considerations already referred to in regard to the effects of phosphates in past years, the slightly higher yield of sound ears on A, together with the general appearance of the crop, leads us to conclude that phosphoric acid on A was not in any considerable excess, but was used in just about the maximum quantity for profit.

4th. Proceeding to a discussion of the results, it appears that the total crop on the plots which had no phosphate was nearly alike and averaged 953 pounds. There was a wider difference in the yield of sound corn (24 pounds.) This was in part due to the difficulty on these plots, not experienced on the others, of making a fair separation of "sound" ears and soft and immature ears. Most of the corn was inferior, but the average yield was 331½ pounds of sound ears. If we call the yield on the no-phosphate plots 100, the yields on the other plots will be as follows:

| | Total Crop. | Sound Ears. |
|---|---|---|
| No-phosphate | 100 | 100 |
| A, Superphosphate | 111 | 144 |
| B, Grand Cayman's | 119 | 141 |
| D, Thomas-Slag | 110 | 140 |
| E, So. Carolina | 101 | 118 |
| G, Plaster | 99 | 113 |
| H, Double quantity superphosphate | 109 | —— |
| X, Stable manure and bone dust | 112 | 139 |

If we deduct from A the increased yield of ears due to gypsum (13) which is shown by G, the comparative yield of sound ears in A is 131.

The difference in total crop is not striking though there is a decided gain over the no-phosphate plots. Where phosphates were used the largest gain was in the weight of the sound ears.

South Carolina Rock showed itself decidedly inferior to the other phosphates, but the Thomas-Slag and the Grand Cayman's

Phosphate produced very nearly the same effect on the crop as was produced by a quantity of superphosphate equivalent to them in cost. This is a point which is of great importance and deserving of further study. A single series of experiments is by no means decisive. The season was particularly good for corn raising and this fact probably was to the advantage of plots B, D, and E, as compared with A, because A grew fastest and matured soonest, and in event of a cold August or an early frost, would probably have yielded much better than the others. The general effect of phosphates is to hasten ripening, and the more available they are, the greater will be this effect. This season, however, was so favorable that both the Thomas-Slag and the Grand Cayman's Phosphate yielded all the phosphoric acid which the crop required.

There is another consideration which is in favor of these undissolved phosphates. In the following table is given: 1st, The total quantity of phosphoric acid applied in each case reckoned on an acre; 2d, The quantity removed by the crops harvested, as determined by analysis, and 3d, The quantity still remaining in the soil.

| Plot. | Applied. Lbs. | Removed by crop. Lbs. | Remaining in the soil. Lbs. |
|---|---|---|---|
| A | 40.6 | 23.9 | 16.7 |
| B | 132.2 | 24.5 | 107.7 |
| D | 105.3 | 23.0 | 82.3 |
| E | 140.0 | 21.1 | 118.9 |

There is every reason to suppose that a part, at least, of the phosphoric left in the soil is as available as that which was removed by the crop and will come to use another year.

This subject is worth further consideration and experiment.

In conclusion, our thanks are due to Mr. Bartholomew for his accuracy, care and skillful management of the experiment which could not have been more successfully carried out at the Station and under our constant supervision.

# CONTRIBUTIONS TO THE CHEMICAL STATISTICS OF THE INDIAN CORN CROP.

In case of most cultivated field and garden plants, data are at hand from which can be calculated with fair accuracy the quantities of vegetable substance of the various kinds which are produced upon an acre, as well as the amounts of ash-ingredients and nitrogen withdrawn from the soil by the crop.

The numerous analyses which supply these data have mostly been made in Germany and Austria where maize is not cultivated except in the southern districts of those countries and there more as forage than for the seed grain.

As a consequence very few statistical analyses of the mature maize plant in all its harvested parts are on record and therefore the opportunity furnished by the field trials just described was taken advantage of to enlarge our knowledge in this respect.

Dr. Jenkins carefully sampled the field-cured crop on Plot X, and full analyses of the several kinds of agricultural material thus secured, are here placed on record.

The SOUND CORN AND COB from one-eighth of an acre weighed 462 pounds. A fair sample weighing 10,200 grams (about 22½ pounds) was air-dried in the laboratory and shelled. The shelled corn weighed 6,215 grams and the cob 1,005 grams. The ratio of cob to corn is 1 : 6·18.

The SOFT AND IMMATURE CORN AND COB ("nubbins") from one-eighth of an acre weighed 65 pounds. A fair sample, weighing 4,235 grams (about 9⅓ pounds) was air-dried and shelled. The shelled corn weighed 2,500 grams and the cob 530 grams. The ratio of cob to corn is 1 : 4·72.

The FIELD-CURED STALKS (including leaves and husks) from one-eighth of an acre weighed 545 pounds. The stalks from six stacks or shooks were cut into two-inch pieces in a feed cutter, thoroughly mixed and 9,300 grams (20½ pounds) of the mixture were dried in the laboratory at a gentle heat. After coarse grinding a sub-sample of 685 grams was finely ground and allowed to stand for 24 hours exposed to the air. It then weighed 734 grams and was preserved in a tight bottle for analysis.

The samples thus prepared were analyzed with the results that follow:—

The statements giving the per cents of the several ingredients or classes of ingredients that commonly serve as the basis of computing food-values are termed *proximate analyses.* Besides these, are also given detailed *ash-analyses.*

### Proximate Analyses of the Different Parts of the Maize Crop, Air-dry. Per cent.

| | Sound Corn. (In the ear.) | | Soft Corn, (In the ear.) | | |
|---|---|---|---|---|---|
| | Kernel. | Cob. | Kernel. | Cob. | Stalks. |
| Water | 8.71 | 7.28 | 9.43 | 7.50 | 8.40 |
| Ash* | 1.23 | 1.39 | 1.32 | 2.00 | 6.26 |
| Albuminoids† | 11.06 | 2.00 | 10.44 | 2.81 | 6.93 |
| Fiber | 1.07 | 33.24 | 1.32 | 31.93 | 29.75 |
| Nitrogen-free Extract‡ | 72.28 | 55.49 | 72.50 | 55.20 | 47.08 |
| Fat (Ether Extract) | 5.65 | .60 | 4.99 | .56 | 1.58 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

It is noticeable, in contrasting the sound with the soft corn, that while the per cent. of albuminoids in the kernels of the former is somewhat greater than in those of the latter, in the cob the relation is reversed. A similar compensation is seen in case of fiber; the soft kernels contain relatively more than the sound, but the soft cobs less. These differences stand connected with the maturing process. The sound, i. e., ripe corn is, pound for pound of dry matter, somewhat more nutritious than the soft. The soft corn in air-drying also retains a little more water than the sound.

### Composition of the Different Parts of the Maize Crop, Field Cured. Per cent.

| | Sound Corn. Kernel and Cob. | Soft Corn. Kernel and Cob. | Stalks. |
|---|---|---|---|
| Water | 35.25 | 34.99 | 48.65 |
| Ash | .89 | 1.03 | 3.50 |
| Albuminoids | 6.93 | 6.51 | 3.89 |
| Fiber | 3.93 | 4.77 | 16.69 |
| Nitrogen-free Extract | 49.50 | 49.69 | 26.41 |
| Fat (Ether Extract) | 3.50 | 3.01 | .88 |
| | 100.00 | 100.00 | 100.00 |

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* Free from charcoal, carbonic acid and water.

† More correctly nitrogen reckoned as albuminoids. Amide-nitrogen, etc, are included.

‡ Starch, sugar, gum, and similar carbhydrates reckoned by difference.

This statement is derived from the foregoing analyses by calculation, the ascertained loss of water in passing from the field-dry to the air-dry (or more correctly house-dry) state and the proportions of kernel to cob, being important factors in the reckoning.

The sound corn and soft corn in the ear, field-cured, have very nearly the same per cent. of water. The soft corn has almost half a per cent. less of albuminoids as well as of fat than exists in the sound corn, and eight-tenths of a per cent. more fiber. This inferiority is in part due to the greater proportion of cob to kernel in the soft corn.

## COMPOSITION OF THE ASH OF THE DIFFERENT PARTS OF THE MAIZE CROP. PER CENT.

| | KERNELS, | | COB, | | |
|---|---|---|---|---|---|
| | of Sound Corn. | of Soft Corn. | of Sound Corn. | of Soft Corn. | STALKS. |
| Potash ($K_2O$) | 30.84 | 30.82 | 61.16 | 58.49 | 39.28 |
| Soda ($Na_2O$) | .68 | .72 | .75 | .97 | .81 |
| Lime ($CaO$) | .61 | .78 | 1.44 | 2.02 | 8.02 |
| Magnesia ($MgO$) | 15.11 | 14.30 | 2.28 | 3.31 | 3.43 |
| Oxide of Iron ($Fe_2O_3$) | trace | trace | .10 | .14 | .83 |
| Sulphuric Acid ($SO_3$) | .78 | 1.68 | 2.59 | 3.70 | 3.18 |
| Phosphoric Acid ($P_2O_5$) | 48.64 | 47.71 | 4.73 | 6.22 | 4.75 |
| Chlorine | .14 | .28 | 4.74 | 6.32 | 8.38 |
| Silica and Sand (by difference) | 3.23 | 3.77 | 23.30 | 20.10 | 33.21 |
| | 100.03 | 100.06 | 101.09 | 101.27 | 101.89 |
| Deduct Oxygen equivalent to Chlorine, | .03 | .06 | 1.09 | 1.27 | 1.89 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Per cent. of Ash | 1.23 | 1.32 | 1.39 | 2.00 | 6.26 |

Of the total quantity of ash in the cob, nearly or quite three-fifths consists of actual potash. In the cob the potash is probably chiefly combined with organic acids and in the ash remains as carbonate. These facts justify the common impression that cob-ashes are particularly valuable for soap-making or for fertilizing purposes.

The ash of the stalks has a higher per cent. of potash than the kernel. The per cent. of phosphoric acid in the stalks is small, about like that of the cob.

Nearly half the ash of the kernel consists of phosphoric acid, which is mostly combined with potash and magnesia, so that we may say the ash of the seeds of maize, as of other cereal grains, is nine-tenths or more phosphates of potash and magnesia.

### COMPOSITION OF THE FIELD-CURED MAIZE CROP. POUNDS PER ACRE.

| | SOUND CORN. | | SOFT CORN. | | STALKS. | TOTAL. |
|---|---|---|---|---|---|---|
| | Kernel. | Cob. | Kernel. | Cob. | | |
| Water | 1303 | | 182 | | 2119 | 3604 |
| Ash | 27.7 | 5.1 | 4.1 | 1.3 | 153.1 | 191.2 |
| Albuminoids* | 249.0 | 7.3 | 32.1 | 1.8 | 169.7 | 459.9 |
| Fiber | 24.1 | 121.1 | 4.1 | 20.8 | 727.7 | 897.6 |
| Nitrogen-free Extract | 1627.3 | 202.1 | 222.4 | 35.9 | 1151.9 | 3239.6 |
| Fat (Ether Extract) | 127.2 | 2.2 | 15.3 | .4 | 38.7 | 183.7 |
| Total | 3696 | | 520 | | 4360 | 8576.0 |

From this statement it appears that more than a third of the most valuable food-ingredient of the crop, namely the albuminoids, was contained in the stalks; about the same relative amount of the nitrogen-free extract and about one-fifth of the fat was also found in the stalks.

The food-value of maize stalks is generally recognized, though they are often used carelessly, being thrown into the barnyard to be picked over by the cattle and then worked into the manure. As far as the chemical composition of their dry matter goes they compare very favorably with timothy or meadow hay, as the following statement shows:

### COMPOSITION OF THE DRY MATTER OF FIELD-CURED CORN-STALKS, TIMOTHY HAY AND MEADOW HAY OF AVERAGE QUALITY.

| | Corn Stalks. | Timothy. | Meadow Hay. |
|---|---|---|---|
| Ash | 6.83 | 4.58 | 5.57 |
| Albuminoids | 7.57 | 6.74 | 7.38 |
| Fiber | 32.47 | 33.82 | 36.79 |
| Nitrogen-free Extract | 51.40 | 52.50 | 47.85 |
| Fat | 1.73 | 2.36 | 2.41 |
| | 100.00 | 100.00 | 100.00 |

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* More properly nitrogenous matters reckoned as albuminoids.

ASH-INGREDIENTS AND NITROGEN IN THE MAIZE CROP. (Pounds per acre.)

| | Sound Corn. Kernel. | Sound Corn. Cob. | Soft Corn. Kernel. | Soft Corn. Cob. | Stalks. | Total. |
|---|---|---|---|---|---|---|
| Potash | 8.5 | 3.2 | 1.3 | .8 | 60.2 | 74.0 |
| Soda | .2 | trace | trace | trace | 1.2 | 1.4 |
| Lime | .2 | .1 | trace | trace | 12.3 | 12.6 |
| Magnesia | 4.2 | .1 | .6 | trace | 5.3 | 10.2 |
| Oxide of iron | trace | trace | trace | trace | 1.3 | 1.3 |
| Sulphuric Acid | .2 | .1 | .1 | .1 | 4.9 | 5.4 |
| Phosphoric Acid | 13.5 | .2 | 1.9 | .1 | 7.3 | 23.0 |
| Chlorine | trace | .2 | trace | .1 | 12.8 | 13.1 |
| Silica and Sand | .9 | 1.2 | .2 | .2 | 50.9 | 53.4 |
| | 27.7 | 5.1 | 4.1 | 1.3 | 156.2 | 194.4 |
| Deduct oxygen equivalent to chlorine | .... | .... | .... | .... | 3.1 | 3.2 |
| Total | 27.7 | 5.1 | 4.1 | 1.3 | 153.1 | 191.2 |
| Nitrogen | 39.8 | 1.2 | 5.1 | .3 | 27.2 | 73.6 |

From this table it appears that more than four-fifths of the potash taken from the land by this corn crop, one-third of the phosphoric acid and more than one-third of the nitrogen were contained in the stalks.

The demand of this crop upon the soil for nitrogen and potash removed in the harvest was the same—74 lbs. per acre. The amount of phosphoric acid carried off was but 23 lbs.

It will be interesting here to compare these figures with the results of a similar investigation made at the New Jersey station in 1883.* In this experiment a variety of Dent corn was planted in hills 3½ feet apart each way on land heavily manured. It yielded 68.3 bushels of shelled corn and 2.2 tons of dried stalks per acre. The total yields per acre were as follows:

| | Kernels. | | Cobs. | | Stalks. | | Total. | | Entire crop reckoned on 1000 lbs. of dry substance. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N. J. | Ct. | N. J. | Ct. | N. J. | Ct. | N. J. | Ct. | N. J. | Ct. |
| Ash | 55.4 | 31.8 | 12.6 | 6.4 | 193.9 | 153.1 | 261.9 | 191.3 | 34.5 | 38.5 |
| Albuminoids | 328.9 | 281.1 | 18.4 | 9.1 | 165.3 | 169.7 | 512.6 | 459.9 | 67.4 | 92.5 |
| Fiber | 69.2 | 28.2 | 269.2 | 141.9 | 1313.0 | 727.7 | 1651.4 | 897.8 | 217.2 | 180.6 |
| Nitrogen-free Extract | 2602.7 | 1849.7 | 483.6 | 238.0 | 1895.3 | 1151.9 | 4981.6 | 3239.6 | 655.3 | 651.5 |
| Fat | 149.5 | 142.5 | 2.8 | 2.6 | 42.8 | 38.7 | 195.1 | 183.8 | 25.6 | 36.9 |
| | 3824.0 | 2333.3 | 950.0 | 398.0 | 4041.0 | 436.0 | 7602.6 | 4972.4 | 1000.0 | 1000.0 |
| Nitrogen | 52.7 | 43.9 | 2.9 | 1.5 | 26.3 | 27.2 | 81.9 | 72.6 | 10.8 | 14.6 |
| Phos. Acid | 27.2 | 15.4 | 2.6 | .3 | 15.0 | 7.3 | 44.8 | 23.0 | 5.9 | 4.6 |
| Potash | 15.3 | 9.8 | 4.8 | 4.0 | 33.1 | 60.2 | 53.2 | 74:0 | 7.0 | 14.9 |

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* Report of the New Jersey Agricultural Experiment Station, 1884, p. 127.

In 1000 lbs. of dry matter the Connecticut crop contained considerably more albuminoids and fat and correspondingly less fiber than the New Jersey crop, the proportion of non-nitrogenous extract (i. e., starch, sugar and the like), being nearly the same in both. It is remarkable that the Connecticut crop contained more than twice the proportion of potash that existed in the New Jersey crop. These striking differences as well as the widely unlike total yield of grain and stalks, stand related, no doubt, largely to difference in the varieties of the corn that were the subjects of trial, and in a less degree to difference of climate and season as well as to quality of soil and quantity of fertilizers.

Indian corn exhibits a very great diversity of development according to external conditions and the large dent varieties may be expected to differ greatly from the smaller flint sorts in their requirements as they do in their dimensions of stalk and ear.

The differences in percentage composition of the kernel, however, will be comparatively slight.

Investigations at the New Jersey Experiment Station have shown:

1st. That a larger quantity of digestible food may be obtained from an acre of field corn than from an acre of fodder corn, *if the stalks are fed without waste.*

2d. That the digestible carbhydrates (digestible fibre and nitrogen-free extract together) of corn meal and corn stalks when fed to cows do not differ in their effect on the quantity of milk produced.

3d. That the substitution of corn ensilage for corn meal and corn stalks does not affect the flow of milk.

4th. It was demonstrated that corn stalks, cut and finely shredded, were eaten as clean and were as valuable feed as hay.

## Relative Feeding-Value of the Leaves, Husks and Stripped Stalks.

No data were gathered on this point for the flint corn raised by Mr. Bartholomew. Later in the season we obtained from Mr. J. J. Webb, of Hamden, a sample of the stover which he was then feeding. The variety was "White Edge Dent." This stover is stacked near his barns in stacks 15 feet in diameter, and 12 to 15 feet high. These apparently suffer damage from the weather only to a depth of a very few inches. As needed, the stover or fodder corn is taken to the barn. The sample which we took, though not sensibly damp, contained, as the analysis shows, more water by 20 per cent. than field-cured stover usually contains. It had, however, a bright, fresh color and no trace of musty or moldy smell. The leaves and husks were separated completely, and the stripped stalks were cut in two at the sixth joint from the butt, so that the two pieces were about equal in length.

The weights of the several parts in the fresh state, the weights of their dry matter and the percentage of the total dry matter which each part contained, are as follows:

| | Fresh (ounces.) | Dry Matter (ounces.) | Per cent. |
|---|---|---|---|
| Leaves | 153.0 | 85.6 | 32. |
| Husks | 124.1 | 59.6 | 22. |
| Upper half of stalks | 57.3 | 31.1 | 12. |
| Lower " " | 267.6 | 91.1 | 34. |
| | 602.0 | 267.4 | 100. |

The analyses of these parts, both in their fresh and water-free condition, are given below.

ANALYSES OF DIFFERENT PARTS OF STOVER, FIELD-CURED.

| | Leaves. | Husks. | Upper half of stalks. | Lower half of stalks. |
|---|---|---|---|---|
| Water | 44.02 | 52.00 | 45.67 | 65.94 |
| Ash * | 5.04 | 2.07 | 2.46 | 1.22 |
| Albuminoids | 4.91 | 2.71 | 1.88 | 1.10 |
| Fiber | 17.98 | 16.79 | 22.57 | 15.03 |
| Nitrogen-free Extract | 27.28 | 25.82 | 26.76 | 16.23 |
| Fat | .77 | .61 | .66 | .48 |
| | 100.00 | 100.00 | 100.00 | 100.00 |

ANALYSES OF DIFFERENT PARTS OF STOVER, WATER-FREE.

| | Leaves. | Husks. | Upper half of stalks. | Lower half of stalks. |
|---|---|---|---|---|
| Ash * | 9.00 | 4.30 | 4.52 | 3.60 |
| Albuminoids | 8.77 | 5.66 | 3.45 | 3.24 |
| Fiber | 32.09 | 34.98 | 41.54 | 44.19 |
| Nitrogen-free Extract | 48.76 | 53.78 | 49.28 | 47.55 |
| Fat | 1.38 | 1.28 | 1.21 | 1.42 |
| | 100.00 | 100.00 | 100.00 | 100.00 |

The following table calculated from the foregoing shows the quantity of each nutrient in each part of 1000 pounds of *dry* (water-free) stover:

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* Free from char, water and carbonic acid.

| | Leaves. | Husks. | Upper part of stalks. | Lower part of stalks. | Total. |
|---|---|---|---|---|---|
| Ash | 28.8 | 9.6 | 5.3 | 12.3 | 56.0 |
| Albuminoids | 28.1 | 12.6 | 4.0 | 11.0 | 55.7 |
| Fiber | 102.7 | 78.0 | 48.4 | 150.5 | 379.6 |
| Nitrogen-free Extract | 156.1 | 119.7 | 57.3 | 162.1 | 495.2 |
| Fat | 4.4 | 2.8 | 1.4 | 4.9 | 13.5 |
| | 320.1 | 222.7 | 116.4 | 340.8 | 1000.0 |

In this experiment with stover from Dent corn it appeared:

1st. About one-third of the dry matter of the stover was in the leaves, one-third in the lower half of the stalks and one-third in the husks and upper half of the stalks.

2d. The leaves, as was to have been expected, were far richer in mineral matter and albuminoids than any other part and had less fiber. The husks in chemical composition stood next in value to the leaves. The upper part of the stripped stalks did not differ greatly in composition from the lower part.

3d. One-fifth of the albuminoids, one-third of the nitrogen-free extract (starch, gum, etc.), and ether extract (fat), and between one-third and one-half of the fiber of the stover were in the lower half of the stalks.

There is no reason to believe that there is any great difference in the digestibility of the different parts of stover, but to make the stalks acceptable to cattle they must be cut, crushed or shredded. On some farms it will pay to do this, on others perhaps not. The observations above cited may be serviceable in helping to a decision in particular cases. Mr. Webb cuts his fodder and field-corn in inch pieces with an ensilage cutter, and his cattle eat it, leaving only very little.

### ON THE

# DETERMINATION OF NITROGEN IN FERTILIZERS CONTAINING NITRATES BY JODLBAUER'S MODIFICATION OF THE KJELDAHL METHOD.

BY E. H. FARRINGTON, M.S.

The Kjeldahl method has proved itself a very convenient and accurate method of determining nitrogen in fertilizers and agricultural products which are free from nitrates.

Jodlbauer (Chem. Centralb. **17**, 433 and Fres. Zeitschr. **26**, 1887, 92) has proposed a modification of the method which renders it applicable to substances containing nitrates as well as to pure nitrates. This modification is essentially as follows:

.2–.5 grm. of a pure nitrate, or a corresponding quantity of a substance containing nitrates is introduced into a flask with 20 cc. concentrated sulphuric acid and 2.5 cc. of phenol-sulphonic acid,—prepared by dissolving 50 grams of crystallized phenol in enough concentrated sulphuric acid to make the volume 100 cc.—and 2–3 grams of zinc dust and 5 drops of platinum chloride solution which contains .04 grams platinum in 1 cc. are also added. After 4 hours boiling in the usual way the liquid is colorless and ready for further treatment according to Kjeldahl's method. By adding to 200 grams phosphoric anhydride enough oil of vitriol to make the volume 1000 cc. and using 20 cc. of this acid instead of pure sulphuric acid, the time required for boiling is reduced one-half but the glass flasks are rapidly attacked.

Stutzer and Reitmair (Rep. Anal. Chem., **7**, 4–6) find that Jodlbauer's method fails to yield accurate results if the acid acts on compact masses of the substance. They obtain good results by proceeding as follows: One gram of substance is introduced into the flask with 25 cc. of water which is evaporated in an air bath and leaves the nitrates more uniformly distributed. 50 cc. of sulphuric acid containing 20 grams of phenol per liter are added and allowed to stand a few minutes. 2–3 grams of zinc dust are then added and one or two drops of mercury and the process is conducted from this point as usual.

In experiments with these methods at this Station it appeared that the digestion in the cold after adding the phenol-sulphonic acid, suggested by Stutzer and Reitmair, was very important.

Better results too were obtained, in the case of fertilizers, with the ordinary commercial 66° acid than with the so-called "chemically pure" acid or with an acid made still stronger by addition of fuming sulphuric acid. An objection to the use of "chemically pure" acid of the trade lies in the fact that it usually contains so much sulphate of ammonia as to make the required correction too large to be satisfactory.

| Station No. | Condition of the Nitrogen. | | | Total Nitrogen found. | | Differences. | |
|---|---|---|---|---|---|---|---|
| | As Nitrates. | As Ammonia. | Organic Nitrogen. | By Dumas' method. | By modified Kjeldahl-Jodlbauer's method. | Minus. | Plus. |
| 1812 | 3.38 | .... | .... | 3.38 | 3.40 | -- | .02 |
| 1872 | 3.24 | .... | .... | 3.24 | 3.27 | -- | .03 |
| 1873 | 3.06 | .... | .... | 3.06 | 3.04 | .02 | -- |
| 1874 | .82 | 1.06 | .58 | 2.56 | 2.49 | .07 | -- |
| 1918 | .74 | .... | 2.45 | 3.21 | 3.16 | .05 | -- |
| 1930 | 1.61 | 1.55 | .69 | 3.92 | 3.78 | .14 | -- |
| 1936 | .52 | .69 | 2.91 | 4.23 | 4.06 | .17 | -- |
| 1949 | .67 | .18 | 2.92 | 3.79 | 3.74 | .05 | -- |
| 1964 | .42 | .... | 2.68 | 3.06 | 3.12 | -- | .06 |
| 1968 | .30 | .65 | 2.97 | 3.97 | 4.06 | -- | .09 |
| 1969 | .51 | .... | 2.73 | 3.16 | 3.27 | -- | .11 |
| 1975 | .30 | .... | 2.55 | 2.85 | 2.89 | -- | .04 |
| 2008 | 1.37 | 2.59 | 1.41 | 5.43 | 5.32 | .11 | -- |
| 2009 | .78 | .60 | 1.16 | 2.58 | 2.50 | .08 | -- |
| 2011 | .79 | .91 | 1.92 | 3.58 | 3.65 | -- | .07 |
| 2013 | .66 | .55 | 1.11 | 2.32 | 2.15 | .17 | -- |
| 2014 | .63 | .05 | 1.73 | 2.48 | 2.34 | .14 | -- |
| 2027 | .51 | 2.36 | 2.79 | 5.68 | 5.65 | .03 | -- |
| 2030 | .62 | 1.06 | 2.31 | 3.98 | 4.00 | -- | 02 |
| 2034 | .45 | .37 | 2.83 | 3.69 | 3.66 | .03 | -- |
| 2035 | .61 | 1.85 | 1.66 | 4.08 | 4.16 | -- | .08 |
| 2036 | 1.14 | 1.29 | 1.51 | 3.95 | 3.93 | .02 | -- |
| 2041 | .58 | .09 | 2.49 | 3.16 | 3.01 | .15 | - |
| 2050 | .79 | .51 | 3.26 | 4.47 | 4.26 | .21 | - |
| 2051 | 4.15 | .... | .38 | 4.56 | 4.49 | .07 | -- |
| 2055 | .54 | 2.69 | 1.42 | 4.48 | 4.65 | -- | .17 |
| 2056 | .66 | 2.41 | 2.43 | 5.44 | 5.46 | -- | .02 |
| 2057 | .83 | 1.87 | 1.94 | 4.61 | 4.66 | -- | .05 |
| 2068 | 3.81 | .... | 1.90 | 5.76 | 5.65 | .11 | -- |
| 2070 | .66 | 2.38 | 1.07 | 4.11 | 3.98 | -- | .13 |
| 2071 | .39 | .... | 2.32 | 2.72 | 2.69 | -- | .03 |
| 2074 | .41 | .57 | 1.85 | 2.83 | 2.82 | .01 | -- |
| 2089 | 3.93 | .... | 1.38 | 5.34 | 5.28 | .06 | -- |
| 2090 | 2.85 | .... | 1.03 | 3.89 | 3.87 | .02 | -- |

Thus 50 cc. of "chemically pure" acid contained .017 grams nitrogen.
50 cc. of fuming sulphuric " " .004 " "
50 cc. of commercial, impure, 66° acid contained .0029 grams nitrogen.

I have found the following precautions and slight modifications to give very satisfactory results in fertilizer analysis.

1 gram of the fertilizer is digested in a flask with 50 cc. of a solution of 50 grams of crystallized phenol in one liter of commercial oil of vitriol of 66° B. This mixture is allowed to stand in the cold for half an hour with frequent shaking. To it are then added 2–3 grams of zinc dust, and .7 gram mercuric oxide. The contents of the flask are then heated gradually and boiled till colorless and subsequently treated according to Kjeldahl's directions.

In the preceding table are given all the results obtained by this method in comparison with results obtained by combustion of the same substances with copper oxide in the way described in the Reports of this Station for 1878 and 1879. The combustions with copper oxide were made by Mr. Winton, the determinations by the Kjeldahl–Jodlbauer method by myself.

An inspection of these results shows that in 68 per cent. of the cases, the difference between the two methods was not over 0.1 per cent. and in 88 per cent. of the cases not over .15 per cent. The greatest difference, No. 2050, was .21 per cent.

The plus differences are 14 in number, the minus differences 20. The average of the former is .066, of the latter .085. It is evident then that the two methods are about equally accurate.

## NOTES ON THE DETERMINATION OF STARCH.

By A. L. Winton, Jr., Ph.B.

The determination of pure anhydrous starch in different varieties of commercial starch may be satisfactorily accomplished by heating the substance with dilute hydrochloric acid according to Sachsse's method, determining the dextrose thus formed by Allihn's method, and from the dextrose found, reckoning the starch.

It is claimed that direct heating of the substance with acid is not admissible in the case of potatoes, grains and other agricultural products, partly because cellulose also is in a measure converted into dextrose by acids and partly because the acid dissolves certain ash ingredients which would be afterwards precipitated by alkaline copper solution.

Several methods for separating the starch from such substances have been devised and it was with the view of learning how they compared with each other as regards accuracy and convenience that the following investigations were undertaken.

### ALLIHN'S METHOD FOR DETERMINATION OF DEXTROSE.*

Since in all the methods for estimation of starch which I have tested with the exception of Asboth's the starch is converted into dextrose, it is of first importance that the method used for determining dextrose should be trustworthy and properly executed.

Allihn's directions are briefly as follows:

For preparing alkaline copper solutions, two solutions are made up.

Solution No. I. contains 173 grms. Rochelle salts and 125 grms. Caustic potash dissolved in water and made up to 500 cc.

No. II. contains 34.69 grms. crystallized copper sulphate dissolved in water and also made up to 500 cc.

60 cc. of alkaline copper solution prepared immediately before using by mixing 30 cc. No. I. and 30 cc. No. II. are heated just to boiling in a beaker of 300 cc. capacity over a lamp. To the boiling liquid 25 cc. of dextrose solution (containing not more than .25 grms. dextrose) are added and the heating further continued until boiling begins again. After the reduced copper suboxide has settled it is collected on a weighed asbestus filter, washed with cold water (at first by decantation) finally with alcohol and ether and dried at 100° C. The copper suboxide is reduced to metallic copper by heating to redness in a stream of dry hydrogen, and to prevent oxidation is cooled in the same gas. From Allihn's table the weight of dextrose, corresponding to the weight of copper, is found.

For an asbestus filter a Gooch crucible with a thick layer of asbestus may be used, although in my experience the filtering tubes described by Allihn are more convenient and retain the finely divided precipitate better. These are easily made from a piece of hard glass tubing 4 inches long and $\frac{3}{8}$ of an inch in diameter by drawing out one end to a small opening and slightly expanding the other. In the narrow portion of the tube a small platinum cone is fitted and a layer of asbestus $\frac{1}{2}$ inch deep is packed in with the aid of a suction pump and a glass rod.

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* Jour. für Prak. Chem., **22**, 52. Fres. Zeit. für Anal. Chem., **22**, 448.

For reducing the copper suboxide the tube is attached by means of a perforated cork to the apparatus which provides a stream of dry hydrogen and after air has been expelled it is carefully ignited in a free flame and cooled before turning off the hydrogen.

In using the method, the following precautions are essential:

I. The solutions for preparing alkaline copper solution must be freshly made and never mixed until immediately before using.

II. After adding the dextrose solution the liquid is simply heated to boiling and *not longer*. 4 minutes boiling brings the result one per cent. or more high.

III. As soon as the precipitate has settled it is collected without further delay on the weighed filter.

IV. Care must be taken that the filter completely retains the precipitate. It is a good practice to let the washings stand for sometime so that if any of the copper suboxide has run through it may subside. In suspension it is hardly visible.

The above method gave me perfectly accurate results with pure, anhydrous dextrose and was used in all the determinations of dextrose which were made in the following investigation.

## Action of Dilute Sulphuric Acid on Dextrose.

Since the methods of determining starch involve a treatment with dilute sulphuric or hydrochloric acid it is important to know whether the dextrose formed in the process is itself subsequently changed by the acid.

The experiments of both Allihn and Salomon seem to show that sulphuric acid is poorly adapted for the conversion of starch into dextrose.

The former in an elaborate series of experiments using .1, .2, .5, and 1 per cent. sulphuric acid, and heating under pressure at temperatures from 100° C. to 114° C. was not able under the most favorable circumstances to obtain more than 95 per cent. of the starch in the form of sugar.

Salomon finds the chief difficulty to be in the change into "humus-like" substances which dextrose undergoes on protracted heating with sulphuric acid. Owing to the formation of such substances the solution gradually darkens in color.

50 cc. of a solution of dextrose which contained 4.678 grms. of the pure dry substance after boiling 4 hours with 20 cc. of 5 per cent. sulphuric acid was found by him to contain but 4.446 grms.

of dextrose, in other words but 95 per cent. of the original quantity. 5 per cent. sulphuric acid is, however, twice the strength of the acid ordinarily used for this purpose.

Prof. R. H. Chittenden (of Yale Univ.) has found that dextrose is not altered on boiling two hours with 2 per cent. sulphuric acid, still a modification of his method described further on in which the starch was first treated with saliva until the solution gave no reaction with iodine solution, then boiled two hours with 2 per cent. sulphuric acid, gave results which were 1 per cent. low.

### Action of Dilute Hydrochloric Acid on Dextrose.

Four portions of pure anhydrous dextrose of about 2.5 grms. each were digested with 2 per cent. hydrochloric acid exactly as prescribed by Sachsse's method to be described further on (page 132) except that the time of heating was varied. After cooling, the acid was nearly neutralized with sodium hydrate, and dextrose determined by Allihn's method.

The following are the results :

| | Time of Heating. | Per cent. of Dextrose. | Color of Solution. |
|---|---|---|---|
| I. | 1 hour | 100.24 | Colorless. |
| II. | 3 hours | 100.22 | Light straw. |
| III. | 11 hours | 96.85 | Dark yellow. |
| IV. | 17 hours | 94.59 | Dark brown. |

The solutions which after one hour's heating still remained colorless and after three hours were but slightly tinged with yellow, on further heating soon began to darken in color.

No. I. and II. show that after three hours heating the dextrose remained practically unchanged, whilst on the other hand III. heated 11 hours was found to have lost 3.15 per cent., IV. heated 17 hours 5.46 per cent. of the original quantity of dextrose. From these experiments we conclude that the action of 2 per cent. hydrochloric acid on the dextrose as employed in Sachsse's method is not sufficient to appreciably affect the results. Heating longer than three hours brings the results low.

In order to have for experiment starch of known composition a quantity was prepared from potatoes and after being allowed to dry in the air was carefully bottled and used in all the following experiments. In this sample, water, ash, fiber and starch were determined by the methods used by Allihn* and Salomon† as follows:—

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* Jour. f. Prak. Chem. 22–79.

† Jour. f. Prak. Chem. 28–84.

*Water:* Two grams were dried to a constant weight at 120° C. in a stream of hydrogen.

*Ash:* The burning to ash was carried on in a muffle furnace at a heat below redness.

*Fiber:* The flocks which remained undissolved after converting the starch into sugar were filtered on a weighed filter, dried at 100° C. and weighed.

*Starch:* By Sachsse's method to be described immediately.

RESULTS OF ANALYSES OF POTATO STARCH.

| | I. | II. | III. | Average. |
|---|---|---|---|---|
| Water | 15.16 | 15.18 | ---- | 15.17 |
| Ash | .63 | .61 | ---- | .62 |
| Fiber | .01 | .03 | --- | .02 |
| Starch | 84.55 | 84.37 | 84.69 | 84.54 |
| | | | | 100.35 |

The most approved methods of determining Starch were next tested as follows:—

### SACHSSE'S METHOD FOR DETERMINATION OF STARCH.

[Chem. Centralbl. 1877, p. 732.]

3 grms. of the air-dry substance are heated in a boiling water bath for 3 hours with 200 cc. water and 20 cc. of a 25 per cent. hydrochloric acid (Sp. gr. 1.125).

The flask is provided with a condenser consisting simply of a long tube ½ inch in diameter attached by means of a perforated rubber stopper. After cooling, enough sodium hydrate solution of known strength is added to nearly (but not quite) neutralize the acid and the liquid is made up to 250 cc. (or some other convenient volume) and an aliquot portion of 25 cc. used for estimating dextrose by Allihn's method already described.

The weight of dextrose multiplied by .9 gives the weight of starch, considering its formula to be $C_6 H_{10} O_5$. In the sample referred to, this method gave 84.54 per cent. of starch.

### PROF. CHITTENDEN'S METHOD OF DETERMINING STARCH WITH USE OF SALIVA.

The details of this method which have been furnished us by Prof. Chittenden are as follows:—

3 grms. of the finely powdered substance are made into a paste of even thickness, with 400 cc. of boiling water. After cooling to

40° C. 15 cc. of filtered and neutralized saliva are added and the temperature kept at 40°* until a drop of the liquid gives no coloration with iodine solution.

For neutralizing the saliva .2 per cent. hydrochloric acid is added drop by drop until the reaction with delicate litmus paper is neutral (the diastatic action of normally alkaline saliva is increased by neutralizing it). An excess of acid must be avoided since .003 per cent. hydrochloric acid almost completely checks the action of the ferment.†

The soluble dextrine and maltose into which the starch has been completely changed, are separated from the insoluble matter by filtering.

The filtrate after concentration to 200 cc. is treated with hydrochloric acid precisely as in Sachsse's method and dextrose is determined by Allihn's method.

The following results on the potato starch of my preparation were obtained by this method.

| | I. | II. | Average. |
|---|---|---|---|
| | 84.45 | 84.85 | 84.65 |
| By Sachsse's method | ---- | ---- | 84.54 |

The advantage which saliva as a ferment in starch analysis has over the malt extract usually employed, is that it does not, like the latter, contain soluble carbhydrates which become converted during the process into dextrose.

When, however, a large number of determinations are to be made and it is impossible for the chemist to supply a sufficient quantity of saliva, malt extract must be used. In this case a blank analysis with the malt extract is made by the same process as the others and a correction made.

Malt extract is best prepared by treating 50 grms. of malt with 1000 cc. of water for 3 hours at 40° C. About 25 cc. of this extract are equivalent to 15 cc. of neutralized saliva.

The digestion of the substance in which starch is to be determined with this ferment solution is carried on at 50°–55° C.

To further illustrate the importance of limiting the heating with dilute hydrochloric acid to three hours, three portions of starch were treated by Chittenden's method exactly as described above except that the heating with acid was continued 17 hours.

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* Studies from the Laboratory of Physiolog. Chem. Sheffield Scientific School, for the year 1884–1885, 121.

† Chittenden, l. c., p. 1.

The results were 3 per cent. low.

| | I. | II. | III. | Average. |
|---|---|---|---|---|
| | 81.15 | 81.88 | 80.93 | 81.32 |
| By Sachsse's method | ---- | ---- | ---- | 84.54 |

In the following trials a 2 per cent. sulphuric acid was substituted for a 2 per cent. hydrochloric acid. The solutions of starch in saliva were boiled gently over a Bunsen burner for 2 hours.

Although the color of the solution was quite dark the results are but 1 per cent. low.

| | I. | II. | III. | Average. |
|---|---|---|---|---|
| | 83.48 | 83.61 | 83.56 | 83.55 |
| By Sachsse's method | ---- | ---- | ---- | 84.54 |

## MÄRCKER'S EARLIER METHOD FOR DETERMINATION OF STARCH IN POTATOES.

[Land. Versuchs. St. 25–107.]

This method was used by Märcker in the analysis of a large number of samples of potatoes. From the results thus obtained he has prepared his tables for the rough estimation of the starch content of potatoes from the specific gravity of the tuber. This method has been extensively employed for the determination of starch in grains and feeding stuffs.

3 grms. of the finely pulverized air-dry potatoes are heated with 50 cc. of water for 4 hours at 135°–140° C. under pressure (3–4 atmospheres). After cooling to 90° the starch which has been converted into the soluble modification is separated from the insoluble matter by filtering with the aid of suction.

The filtrate is made up to 200 cc. and treated with hydrochloric acid as in Sachsse's method. After neutralizing the acid with sodium hydrate, 7–8 cc. of basic lead acetate are added to precipitate pectin substances, and the liquid is made up to 500 cc. and filtered through a dry filter. 200 cc. of the filtrate are made up to 250 cc. with 1 per cent. sulphuric acid and after the precipitated lead sulphate has settled, once more filtered through a dry filter and dextrose determined in 25 cc. of the filtrate.

For converting the starch into the soluble modification we have heated the substance, contained in a brass vessel, covered with a tightly fitting lid together with 50 cc. of water in a Müncke's steam digester.

In using this apparatus care must be taken not to allow the pressure to fall off after digestion so rapidly as to occasion mechanical loss from the violent boiling of the contents of the vessels.

Solution of basic lead acetate is prepared by boiling 155 grms. of lead-acetate and 109 grms. litharge with 400 cc. of water and making the filtrate up to 500 cc.

Results obtained on the nearly pure potato starch agree with those by preceding methods.

| | I. | II. | Average. |
|---|---|---|---|
| By Märcker's method | 84.50 | 84.77 | 84.63 |
| By Chittenden's method | | | 84.65 |
| By Sachsse's method | ---- | ---- | 84.54 |

## MÄRCKER'S LATER METHOD FOR DETERMINATION OF STARCH IN GRAINS AND POTATOES.

[Chem. Zeit. ix, 319.]

[Reprinted Fres. Zeitschr. 24, 617.]

3 grms. of the finely ground substance are heated with 50 cc. of water to 90° C. and after cooling to 65° mixed with 5 cc. cold malt-extract (50 grms. of malt extracted with 1000 cc. water). After digesting ½ hour (at 65° or better at 55°), 10 cc. of 1 per cent. tartaric acid solution are added and the mixture heated under a pressure of 3 to 4 atmospheres for ½ hour as has been described. When cooled to 65°, 5 cc. malt extract are again added and after ½ hour the insoluble portion is removed by filtration. The filtrate is heated on a boiling water bath 2½ hours with 15 cc. of 25 per cent. hydrochloric acid, and enough water to make a volume of 200 cc.

The acid is then nearly neutralized with sodium hydrate and dextrose is determined by Allihn's method. Märcker states that by this method a complete solution of the starch is effected without any appreciable decomposition of the dextrose.

In order to verify this statement and also to study the solvent action of tartaric acid under pressure, 4 portions of potato starch of 2.5 grms. each were weighed out into brass vessels.

I. and II. were treated exactly as has been described with ferment solution and tartaric acid except for reasons before stated 5 cc. of neutralized saliva were substituted for 5 cc. of malt extract.

III. was digested directly with 55 cc. of water and 10 cc. 1 per cent. tartaric acid. The treatment was the same as for I. and II. except that addition of ferment solution was omitted.

IV. was simply heated under pressure for ½ hour with 65 cc. of water.

All four were heated (without filtering) with hydrochloric acid as directed, neutralized with sodium hydrate, made up to 250 cc. and dextrose determined in 25 cc. From the dextrose the percentage of starch was computed.

| | |
|---|---|
| I. | 84.86 |
| II. | 84.47 |
| III. | 84.67 |
| IV. | 84.81 |

These results indicate that the conversion into dextrose was in each case complete.

After digestion with saliva in I. and II. the starch was only partially in solution, although the diastatic action of 5 cc. of saliva is greater than of 5 cc. of malt extract. The quantity of anhydrous starch in 2.5 grms. of potato starch is about the same as in 3 grms. of air-dry potatoes.

The object of this first digestion with ferment solution recommended by Märcker is apparently not to effect complete solution of the starch but to remove the larger part of it so that tartaric acid may act more readily on that which may be enveloped in vegetable tissue.

In III. heated under pressure ½ hour with tartaric acid the solution of the starch was complete, whilst IV. heated in the same way with water alone was still milky from undissolved starch.

The addition of .1 grm. of tartaric acid shortens the time of heating necessary for effecting a complete solution of the starch.

*The results obtained on pure potato starch by both of Märcker's methods and by Chittenden's method agree with those by direct conversion with acid according to Sachsse's method, and with the result got by difference where water, ash and cellulose were determined.*

In each case the starch was brought into solution before the digestion with acid so that if insoluble matter had been present it could have been separated and in each case also the total amount of starch used was obtained finally in the form of dextrose.

### COMPARISON OF THESE METHODS ON POTATOES.

It seemed next desirable for the sake of comparative results to estimate the starch in a sample of potatoes by each of these methods. For this purpose a number of sound potatoes were cleaned, weighed, cut into thin slices and dried in a current of warm air. They were then ground rather coarsely, taking care to avoid loss, and after standing exposed to the air several days were again weighed and a subsample was taken and reduced to a fine meal, all of which passed through a bolting cloth.

This air-dry substance amounted to 24.5 per cent. of the fresh sample.

Duplicate portions of three grams of this air-dry potato-meal were treated as follows:

1. By Märcker's earlier method.
2. Same as 1, except that "pectin substances," etc., were not removed by precipitation with basic lead acetate.
3. By Märcker's later method.
4. By Chittenden's method.
5. By Sachsse's method without separating cellulose, which was filtered out in 1, 2, 3 and 4.

The solutions of dextrose were in each case made up to 250 c. c., and 25 c.c. was used for the determination.

| | Per cent. of Starch found in Air-dry Sample. | | |
|---|---|---|---|
| | I. | II. | Average. |
| 1........ | 67.05 | 66.52 | 66.78 |
| 2........ | 68.60 | 67.98 | 68.29 |
| 3........ | 69.78, 69.30 | 69.46 | 69.51 |
| 4........ | 69.30 | 68.76 | 69.03 |
| 5........ | 71.60 | 71.64 | 71.62 |

It is evident from 1 and 2 that basic lead acetate removes substances which reduce alkaline copper solution; in 2, 3, 4 and 5, however, this was purposely omitted, as probably the error in each case would be the same and would not alter the value of the results for comparison.

The results in 5, where the material was digested directly with hydrochloric acid without previous separation of cellulose, etc., are considerably higher than any of the others. These higher results were at first supposed to be due to the partial conversion of cellulose into dextrose by heating with hydrochloric acid. In order to ascertain whether this supposition was correct, the residues which had been separated in 2, 3 and 4, of which those from 2 and 4 had been dried at 100° and weighed, were soaked in water until soft, then ground to a pulp, and finally digested with two per cent. hydrochloric acid for three hours, neutralized, made up to 250 c.c. and the copper reduced by 25 c.c. was determined.

| | Reduced Copper. | | Per cent. of starch equivalent to copper. | | Per cent. of dry residue. | |
|---|---|---|---|---|---|---|
| | I. | II. | I. | II. | I. | II. |
| 2 | .0010 | .0017 | .... | .... | 5.66 | 5.70 |
| 3 | .0019 | .0022 | .... | .... | Not | weighed. |
| 4 | .0099 | .0131 | 1.96 | 2.56 | 9.33 | 10.37 |

To our surprise the reduced copper in 2 and 3, if added to that obtained from the soluble portion, was not sufficient to make .4 per cent. difference in the results, even if the fact is disregarded, that the boiling of alkaline copper solution alone invariably reduces a little copper.

In 4, on the other hand, the reduced copper was equivalent to 1.96 per cent. of starch in I. and to 2.56 per cent. in II. The weights of the dried residues in this case were also much greater than in 2. In 4, the total reducing power of the soluble portion and residue, after treating with acid, nearly agree with that where the sample was digested directly with acid. Thus:

| | Reducing Power reckoned as Starch. | | |
|---|---|---|---|
| | 4. (Chittenden's saliva method.) | | 5. (Direct conversion.) |
| | I. | II. | |
| Soluble in saliva | 69.30 | 68.76 | .... |
| Insoluble in saliva | 1.96 | 2.56 | .... |
| Total | 71.26 | 71.32 | 71.60 |

What the residues in 4 contained after digestion with hydrochloric acid which reduced alkaline copper solution is not known. Possibly the starch was not completely in solution or the washings may have been incomplete, as the residue was slimy and was washed with difficulty, but it cannot be concluded that cellulose was converted to such an extent into dextrose, since little or no reduced copper was obtained when the residues in 2 and 3 were treated in the same way.

Why the results by either of Märcker's methods are lower than those by direct conversion cannot be explained except by considering that an actual decomposition takes place on digestion under pressure.

Our experiments seem to show that pure starch treated by either of Märcker's methods can be completely recovered as dextrose, but in the case of the potato other substances are present which may themselves decompose or may cause a decomposition of starch. The potato also contains water-soluble matters which reduce alkaline copper solution. From the potato-meal here operated on I extracted by cold water matters, reducing copper which reckoned as dextrose amounted to 3.59 per cent. Having proved that in this particular sample of potatoes, the troublesome operations which Märcker employs for removing cellulose previous to digestion with acid are needless, the question arose whether the same would hold true for other samples of potatoes and for the cereal grains and other agricultural products in which it is often desirable to accurately determine starch as a measure of their value for the manufacturer of commercial starch or of alcohol, and also whether it would hold true for pepper in which starch is often determined to decide whether the sample is pure or adulterated.

The following experiments were made to cover these points. Samples of graham flour, maize meal (prepared from the whole kernel), rice (without the hulls), beans and pepper were finely pulverized, and, with the exception of the graham flour, were sifted through bolting cloth.

In portions of 3 grams each, starch was dissolved and separated from the cellulose and other insoluble substances by Märcker's earlier method (digestion with water for 4 hours under pressure of 3–4 atmospheres) and by his later method (digestion with malt-extract ½ hour, then with tartaric acid under a pressure of 3–4 atmospheres ½ hour and finally again with malt-extract). The starch solution was filtered off immediately from the residue, which was washed quickly and thoroughly with boiling water, for when starch is simply brought into solution by digestion under pressure with water alone, it is necessary to filter without delay while hot, as starch is precipitated on cooling.

The residues were digested 3 hours with 200 c.c. of water and 20 c.c. of hydrochloric acid (sp. gr. 1.125) and reducing substances in the resulting solutions after filtration were determined in 25 c.c., corresponding to .3 grams of substance, by Allihn's method and calculated as starch when possible. When the weight of reduced copper is less than 10 milligrams, the reducing substance expressed in terms of starch can not be determined by the use of Allihn's tables.

The results appear in the following statement :—

| | Residues from Märcker's earlier method yielded— | | Residues from Märcker's later method yielded— | |
|---|---|---|---|---|
| | Copper. | Equivalent to per cent. of Starch. | Copper. | Equivalent to per cent. of Starch. |
| Graham flour | .0015 | ---- | .0000 | ---- |
| Maize | .0010 | ---- | .0017 | ---- |
| Rice | .0002 | ---- | .0008 | ---- |
| Potatoes, 1st sample | .0019 | ---- | .0022 | ---- |
| | .0017 | ---- | | |
| Potatoes, 2d sample | .0010 | ---- | .0019<br>0022 | ---- |
| | .0000 | ---- | | |
| Beans | .0060 | .92 | .0073 | 1.11 |
| Pepper | .0087 | 1.33 | .0130 | 1.98 |

These results indicate that in determining starch, no appreciable error is introduced by omitting the separation of cellulose and other insoluble matters before digestion with hydrochloric acid in the case of graham flour, maize meal, rice and potatoes. In the case of beans and pepper there is a considerable quantity of some copper-reducing material produced by the action of acid on the insoluble matters. Whether this is due to hydration of cellulose does not appear. But in those materials in which *accurate* starch determinations are most desirable the insoluble matters yielded only a minute quantity of reducing substance when heated with acid.

As further evidence, a third sample of potatoes from an entirely different source was put through the process for separating cellulose according to Märcker's earlier method, and the residue digested with acid as before. In this case 12 grams of the air-dry substance was used, so that the 25 c. c. of the solution corresponded to 1.2 grams, or four times what had been used in preceding cases. The weight of reduced copper was but .0016 grams.

*We therefore conclude that the simplest and in other respects the most satisfactory method for estimating starch in potatoes and cereal grains, is to digest the air-dry sample directly with a two per cent. hydrochloric acid and proceed in other respects as has been described.*

## NOTES ON ASBOTH'S METHOD OF DETERMINING STARCH.

[Repert. Anal. Chemie. No. 20. Translation in Analyst, xii, 138.]

Asboth has shown that baryta starch $[C_6H_{10}O_5]_4BaO$, first prepared by Zulkowsky by the action of baryta water on soluble starch, is also formed and precipitated when baryta water is added to starch which is simply suspended in water in the form of paste.

On this reaction he bases a volumetric method for the determination of starch in cereals which is here copied from the Analyst, vol. xii, page 140.

### ESTIMATION OF STARCH.

"Weigh out about three grams of the flour and rub well in a mortar with cold water; but in the case of hard substances like maize, rice, peas, boiling water must be used. Pour off into a 250 c. c. flask, and rub residue again and again with small quantities of water, until the bulk of the starch is removed; finally introduce residue also into the flask. Add water up to about 100 c. c., and heat in water-bath for half an hour, with occasional stirring. After cooling, add 50 c. c. of standard baryta water; cork the flask, and shake well for two minutes. To completely separate the baryta starch, add proof spirit up to the mark. After ten minutes pipette off 50 c. c., but if a flocculent precipitate refuses to settle, filter a portion of the fluid through glass-wool contained in a tube." "Titrate the excess of BaO with decinormal hydrochloric acid, using phenolphthalein as an indicator. The interval during the settling of the precipitate I utilized in standardizing the baryta water."

"I use 10 c. c. baryta water, and add 50 c. c. of thoroughly boiled distilled water before checking it." "The difference in BaO between the two determinations was first multiplied by 5, then by 4.235 = amount of starch."

"An analysis can be finished in about an hour and a half. I must call attention to the fact that if the liquid is not frequently shaken during the heating, there will be a tendency to form lumps of starch paste which are but imperfectly acted on by baryta water."

I have tried this method on the pure potato starch previously described with the following results:

| | Asboth's Method. | Sachsse's Method. |
|---|---|---|
| Pure Starch............ | 82.83, 83.02, 83.79 | 84.54 |

With pure starch the titration was quite sharp, the color changing with a single drop of acid, but with potatoes, however, the point of neutrality can only be approximately determined, so that although duplicate results made by the same chemist at the same time may agree, it is extremely difficult to decide whether the point of absolute neutrality has been reached or not.

A little difference of opinion on this point would alter the results one or two per cent. Even with pure starch, where the titration was comparatively easy, it is much more difficult to get sharp results than by gravimetric methods. We have also made determinations of starch by Asboth's method in the [air-dry] potatoes sent by Mr. Platt as follows:

| | Asboth's Method. | | | Sachsse's Method. |
|---|---|---|---|---|
| CCXLVI | 70.14 | 70.87 | | 73.81 |
| CCXLVII | 74.00 | 73.60 | | 73.60 |
| CCLIX | 72.08 | 71.69 | | 69.96 |
| CCLX | 70.00 | 70.22 | | 72.40 |
| CCLXI | 69.88 | 70.66 | | 72.07 |
| CCLXII | 62.11 | 63.19 | 63.62 | 70.60 |
| CCLXIII | 62.97 | 62.29 | | 70.68 |

# ANALYSES OF PARIS GREEN, AND REMARKS ON THE USE OF INSECTICIDES.

Paris Green is now used in large quantities to destroy the potato beetle, and also to protect fruit trees from the codling moth and certain other insect pests. It is a compound of arsenious acid (white arsenic), acetic acid and copper, and owes its poisonous properties to the arsenic in it.

Formerly four or five brands of this article were in the market, "Strictly Pure" being what the name implied, the others consisting of varying proportions of Paris Green and some makeweight.

We have been unable this year to find any other brand than "Strictly Pure" in our market, and are told that no other brand is now manufactured. The following analyses were made by Dr. Osborne, to determine whether the "Strictly Pure" Paris Green in market is what its name indicates:

A. Made by C. T. Raynolds & Co., New York. Bought of W. A. Spalding, New Haven.

B. Made by Raynolds & Co. Bought of R. Wells & Co., New Haven.

C. Bought of Cowles & Leete, New Haven.

D. From a package with Schieffelin's label. Bought of J. H. Klock & Co., New Haven.

E. Bought of F. S. Platt, New Haven.

F. Bought of Davenport & Burt, Putnam.

ANALYSES.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Water | 1.09 | 1.01 | 1.05 | .96 | 1.22 | .94 |
| Copper oxide | 30.90 | 30.94 | 30.77 | 30.87 | 30.54 | 31.05 |
| Arsenious oxide | 57.22 | 57.10 | 57.23 | 57.04 | 56.97 | 57.18 |
| Acetic acid by difference | 10.79 | 10.95 | 10.95 | 11.13 | 11.27 | 10.83 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

The samples cost uniformly 35 cents a pound, except D, for which 40 cents was asked.

Paris Green is manufactured in this country by several companies who have formed an association to control the production and price. Their prices for next season they have not yet made public but they have already guaranteed that prices will be lower than last year. At present Paris Green can be bought at retail for 35 cents per pound, and in large lots at 28 to 30 cents, but not under that. Dealers cannot buy it of the manufacturers in 500 lb. lots for less than 18 cents.

At present London Purple is a much cheaper insecticide than Paris Green. It should contain nearly as much arsenic, and costs less than half as much. Still another insecticide which could be obtained much more cheaply than either of those named is "White Arsenic," which consists wholly of arsenious acid, and therefore has from 1.7 to 2 times as much poison in it pound for pound as either Paris Green or London Purple. A common price for it at the apothecaries, is 25 cents a pound. But it sells at wholesale for 3 cents, and reliable druggists say that it would sell for 6 or 8 cents retail if there was any demand for it. A very serious objection to the use of "White Arsenic," however, is its pure white color, which makes it resemble saleratus, soda, salt, and other things used in cooking. Neither London Purple or Paris Green could be so mistaken. If "White Arsenic" is bought, it should *never* be taken from the shop until mixed with lampblack or pulverized charcoal. One-fifth of an ounce of either is sufficient to blacken a pound of arsenic.

Prof. A. J. Cook, of the Michigan Agricultural College, in a letter on the subject, says:

"The danger, through carelessness, from the use of Paris Green or London Purple is almost as nothing compared with that of White Arsenic. I have thoroughly experimented with both the latter, and find not a trace of them in the foliage of potatoes, nor in the tubers, when every advantage was given for such absorption. I have done the same with apples. No trace of the poison is found on or in the fruit. White arsenic is easily mixed, is very effective, and as far as I have tried it, does no more harm to vegetation. But I do not think it cheaper than London Purple, and no better. I have found this year that one-half pound of London Purple to 100 gallons of water is enough.

The mixture above referred to is designed for spraying fruit trees.

One pound of Paris Green mixed with 100 pounds of plaster is sufficiently strong to use on potatoes. It has been repeatedly noticed that a large quantity of the poison is less efficacious than a small one, perhaps because the beetle avoids a mass of it, while the barest trace is as deadly as any larger quantity. Many prefer to use the poison in water, because there is less danger of inhaling it. In that case a heaping spoonful in a pail of water is enough.

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# THE METHODS OF MECHANICAL SOIL-ANALYSIS.

By Thomas B. Osborne, Ph.D.

In the report for 1886 were given the first results of an investigation of the methods of mechanical soil-analysis. The method of Knop as modified by Moore and that of Hilgard, as well as one developed in the Station laboratory were there discussed and compared. Since then the investigation has been extended to Schöne's method, and to the process of Schlösing which combines chemical and mechanical treatment.

These methods comprise all hitherto proposed that now appear to be worthy of investigation, the others such as Schulze's, Nöbel's, Müller's, Kühn's, Masure's and others, either employ conical elutriating vessels, which as Hilgard has pointed out and this investigation fully confirms, give wholly incorrect results, or they are methods depending on subsidence through a given height of water for a definite length of time, a principle which experience has shown is not adapted to yield results of value with any certainty whatever.

### SCHÖNE'S METHOD.

The apparatus used, obtained from Müncke, of Berlin, was similar to that described and figured by Schöne (Zeitschrift f. Analytische Chemie, 7, 1868, p. 29), with the addition, suggested by Orth, of a second elutriating tube having a diameter one-half that of the Schöne tube.* Water was supplied to the apparatus under a constant pressure by means of a Mariotte's bottle.

Schöne's elutriator has been so frequently described that any further reference to its construction is unnecessary. The hydraulic values of the different currents used were not directly determined but the flow of water was so regulated as to carry off only such particles as had diameters equal to or less than the upper limit of the grade to be separated. It was thus easy to obtain results strictly comparable with those given by the other methods used.

In the first trial made, the soils were subjected to no preparatory treatment beyond simple sifting. The samples were neither boiled with water nor acted on by hydrochloric acid nor by alkali-solutions.

Schöne, in his original paper, following Schübler and Schulze, prescribes boiling as a needful preliminary in all cases. Clayey soils containing much humus he says should be boiled an hour with water containing in solution 1–2 per cent. of alkali hydroxide. Sandy soils he directs to free from organic matters by ignition and calcareous earth he recommends to treat with cold dilute hydrochloric acid to remove carbonate of lime.

As serious objections may be urged against all these last mentioned modes of preparation, it was determined to make some trials on the simply sifted earth, in order to gain an idea of the extent to which the soil could be differentiated without their aid, the results of applying the method of Beaker elutriation being employed as standards of comparison.

Twenty grams of the air-dry soil were sifted under water through a quarter-millimeter sieve. The fine material which after passing the sieve remained suspended in the water was poured into the Schöne tube, the coarser portion being rinsed into the Orth tube. The water current was then regulated so that the largest particles of quartz carried off had an average diameter of .01$^{mm}$.

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* Die Agronomische Bodenuntersuchungen und Kartirung, von Dr. Max Fesca, Berlin, 1879, pp. 19, and 143, also Albert Orth, Ueber Mechanische und Chemische Bodenanalyse. Bericht d. D. Ch. Gesellschaft, xv, p. 3026.

When the current ceased to remove any appreciable quantity of the soil its velocity was increased so that the largest quartz grains passing over had a diameter of .05$^{mm}$. These portions were collected in separate vessels.

As Hilgard noticed in the case of Schulze's elutriator, secondary currents formed during the process of elutriation which descended along the walls of the conical part of the Schöne tube and for some distance along the sides of its cylindrical portion. The result of these currents was to produce globular aggregates of small particles which fell to the bottom of the tube. These flocculæ could be to some extent broken up by turning on from time to time for a few seconds a rapid current of water, but a very considerable proportion of them remained unbroken to the end of the elutriation and were only moved forward when the current was increased so as to carry off the coarsest grade.

SOIL FROM GARDEN OF THE EXPERIMENT STATION.—NOT BOILED.

ANALYSES WITH THE SCHÖNE–ORTH ELUTRIATOR.

| | A. | B. |
|---|---|---|
| Above .25$^{mm}$ | 48.82 | 48.82 |
| .25–.05$^{mm}$ | 27.36 | 29.94 |
| .05–.01$^{mm}$ | 8.63 | 6.07 |
| .01– 0$^{mm}$ | 7.36 | 7.31 |
| Clay (by difference)* | 1.00 | 1.03 |
| Loss on ignition | 6.83 | 6.83 |
| | 100.00 | 100.00 |

The coarser products obtained in these analyses, under the microscope were seen to contain material finer than properly belonged to them. The various sediments of A were therefore subjected to systematic beaker elutriation and the finer material thus readily separated was in each case weighed and its quantity added or subtracted as required to make the obvious corrections. The following figures show the outcome of this correction compared with the original analysis and with the results of direct beaker elutriations.

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* "Clay," as given in this and in the other analyses by the Schöne and Beaker methods instanced in this paper, is, in accordance with Hilgard's conventional method, that part of the grade having diameters of from .01–0$^{mm}$ which remains suspended after 24 hours' sedimentation from water having a depth of 200$^{mm}$.

Neither Schöne nor the various experimenters who have employed his method in analysis of soils appear to have undertaken to subdivide the grade .01–0$^{mm}$.

SOIL FROM GARDEN OF THE EXPERIMENT STATION.—NOT BOILED.

| | A. Schöne-Orth Elutriation. | A-1. A. Corrected by Beaker Method. | Average of 3 Direct Beaker Elutriations.* |
|---|---|---|---|
| Above .25mm | 48.82 | 48.82 | 48.82 |
| .25–.05mm | 27.36 | 23.72 | 22.37 |
| .05–.01mm | 8.63 | 12.08 | 13.70 |
| .01– 0mm | 7.36 | 7.55 | 7.20 |
| Clay (by difference) | 1.00 | 1.00 | 1.08 |
| Loss on ignition | 6.83 | 6.83 | 6.83 |
| | 100.00 | 100.00 | 100.00 |

The agreement between the results by direct beaker elutriation and the corrected Schöne-Orth elutriation is perhaps quite as close as could be expected. The uncorrected S.-O. elutriation materially differs from the direct beaker analysis in the 2d and 3d grades only and by five per cent. in each case.

The sample of Prairie soil whose analyses by other methods were reported last year was next examined. Fifteen grams were carefully worked with a rubber pestle to disintegrate as far as practicable all the lumps and separate the loosely adhering particles. The sample was then elutriated in the manner just described. The following figures show the results thus obtained as well as those yielded by the beaker method, as given in the Report of this Station for 1886, p. 157.

PRAIRIE SOIL FROM MERCER COUNTY, ILL.—NOT BOILED.

| | C. Schöne-Orth Elutriation. | No. 33. Beaker Method. |
|---|---|---|
| Above .25mm | .76 | .62 |
| .25–.05mm | 11.25 | 2.42 |
| .05–.01mm | 52.65 | 43.58 |
| .01– 0mm | 14.84 | 31.58 |
| Clay | 4.44 | 5.81 |
| Loss on ignition | 14.49 | 14.49 |
| | 98.43 | 98.50 |

Here the differences between the results of the two methods are such as to show positively that the Schöne process is worthless, when applied to an unboiled soil of this character. This prairie earth is difficult to elutriate with a current of water because of its large content of very finely divided organic matter.

A sample of brick clay elutriated as in the above analyses gave the following results:

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* Report of Conn. Ag. Exp. Station for 1886, p. 148.

BRICK CLAY FROM NORTH HAVEN, CONN.*

| | D. Schöne-Orth Elutriation. | No. 50. Beaker Method. |
|---|---|---|
| Above .25mm | 1.02 | 1.02 |
| .25–.05mm | 3.91 | .76 |
| .05–.01mm | 29.63 | 20.95 |
| .01– 0mm | 58.58 | 71.01 |
| Loss on ignition | 6.60 | 6.60 |
| | 99.74 | 100.34 |

We note that in this ancient drift deposit which has never been cultivated and contains no visible organic debris the Schöne elutriation totally fails to make even a rough separation of the several grades of fine matter from the unboiled soil. This failure is doubtless partly due to the fact that the current of water cannot fully disintegrate the clay, but it is also due in part to the coalescence of once separated particles as they encounter each other in the elutriating process. The coarser products of elutriation contained large numbers of fine particles which under the microscope were seen adhering to one another in groups of from four or five up to twenty or thirty. During the analysis these flocculæ could be seen at all times in the process of formation in the elutriator, and when once formed, as Hilgard has shown, they adhere together with great persistence.

## THE BERLIN-SCHÖNE METHOD.

In his original paper as printed 20 years ago in *Fresenius' Zeitschrift*, Schöne gave no definite instructions with regard to the proper duration of boiling as preliminary to the elutriating process, nor have any further communications from him on the subject appeared in the current literature. In the mean time his apparatus as modified by Orth has been adopted and extensively employed in the *Laboratorium für Bodenkunde*, of the Royal Prussian Geological *Landesanstalt* at Berlin. The elutriations by the Schöne apparatus that remain to be described in this paper were made as nearly as possible in accordance with the instructions that have emanated from the Berlin *Bodenlaboratorium* and are as follows:†

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* Not the sample analyses of which were given in Report of this Station for 1886.

† Untersuchungen des Bodens der Umgegend von Berlin, von Dr. Ernst Laufer und Dr. Felix Wahnschaffe, Berlin, 1881, pp. 14–24; also Dr. Max Fesca, Agr. Bodenuntersuchungen, p. 143. Dr. Wahnschaffe's lately published work, "Bodenuntersuchungen" had not been received when this paper went to the printer.

500 grams of the soil are sifted upon circular holes 2$^{mm}$ diameter. Of the earth passing the sieve 30 to 100 grams are boiled in water with constant stirring for from one-half to one hour or longer, according to the character of the soil. The finer the texture of the soil the smaller the quantity taken and the longer the time of boiling. Treatment with acids or alkalies is not practiced.

The finer portion of the soil remaining suspended in the water after boiling is poured into the Schöne tube, the remaining coarse part is rinsed into the Orth tube. The clay, together with the finest sand, is collected in a separate vessel, the water in which it is suspended is evaporated off and the residue after drying in the air is weighed. The rest of the operation is carried out as previously described except that the products of elutriation are not ignited but weighed air-dry, in order that they may be further examined chemically if desired. By proceeding in this manner the following results were obtained:

SOIL FROM THE GARDEN OF THE EXPERIMENT STATION, boiled 45 minutes.

*Separations by the Berlin-Schöne Method.*

| | Air dried. | Ignited. |
|---|---|---|
| Above .05$^{mm}$ | 72.63 | 71.76 |
| .05–.01$^{mm}$ | 14.17 | 12.53 |
| .01–0 | 12.97 | 9.38 |
| Loss on ignition | .... | 6.83 |
| | 99.77 | 99.50 |

For the sake of comparing the mechanical separations attainable by this procedure with those yielded by other methods, the air-dry products were ignited and again weighed and our further statements have reference chiefly to the latter.

By subtracting from the ignited portion above .05$^{mm}$, 49.37 per cent. the amount of this soil that remained upon a .25$^{mm}$ sieve, the fraction between .25$^{mm}$ and .05$^{mm}$ is found and the separations in this analysis may be compared with those previously obtained by the Beaker Method as follows:—

SOIL FROM GARDEN OF EXPERIMENT STATION.

| | E. Berlin-Schöne Boiled 45 min. | Beaker Method. | | |
|---|---|---|---|---|
| | | Boiled 23 hours av. of 4 analyses. | No. 29. Pestled, not boiled. | Not boiled nor pestled, av. of 3 analyses. |
| Above .25$^{mm}$ | 49.37 | 47.77 | 48.82 | 48.82 |
| .25–.05$^{mm}$ | 21.39 | 20.75 | 22.44 | 22.37 |
| .05–.01$^{mm}$ | 12.53 | 11.18 | 12.55 | 13.70 |
| .01–0 clay included | 9.38 | 13.47 | 9.36 | 8.28 |
| Loss on ignition | 6.83 | 6.83 | 6.83 | 6.83 |
| | 99.50 | 100.00 | 100.00 | 100.00 |

Separations thus accomplished by the Berlin-Schöne method, show a very remarkable quantitative agreement with those made by the beaker method but the coincidence is more apparent than real, for on subjecting the two coarser products to beaker elutriation they were each found to contain a not inconsiderable amount of material belonging to the finer grades. The boiling for only a short time had, apparently, given the sample a composition quite different from that obtained on elutriating the unboiled soil but had not reduced it to the condition of those samples which were boiled for 23 hours. See analyses A and B, p. 146.

The following figures show the weights and per cents. of material removed by beaker elutriations from the 2d and 3d products of the foregoing analysis:

| | Wt. of fractions in grams. | Wt. of substance removed. | Per cent. removed. |
|---|---|---|---|
| | *Air Dried.* | | |
| $.25^{mm}$ to $.05^{mm}$ | 22.31 | 2.84 | 12.76 |
| $.05^{mm}$–$.01^{mm}$ | 14.17 | 1.19 | 8.37 |
| | *Ignited.* | | |
| $.25^{mm}$–$.05^{mm}$ | 21.39 | 2.37 | 11.07 |
| $.05^{mm}$–$.01^{mm}$ | 12.53 | .81 | 6.48 |

The above figures supply the data for calculating a corrected Berlin-Schöne analysis which is here compared with the uncorrected analysis and with results of a beaker elutriation made directly on a sample of the same soil boiled for the same time, viz: three quarters of an hour.

SOIL FROM GARDEN OF EXPERIMENT STATION, boiled 45 minutes.

| | E. Berlin-Schöne Method. | E. 1. E. Corrected by the Beaker Method. | No. 49. Beaker Method. |
|---|---|---|---|
| Above $.25^{mm}$ | 49.37 | 49.37 | 49.52 |
| $.25$–$.05^{mm}$ | 21.39 | 19.02 | 19.50 |
| $.05$–$.01^{mm}$ | 12.53 | 14.09 | 13.11 |
| .01–.0 | 9.38 | 10.19 | 11.04 |
| Loss on ignition | 6.83 | 6.83 | 6.83 |
| | 99.50 | 99.50 | 100.00 |

In case of heavy loams the inability of the Berlin–Schöne method to effect even a roughly approximate separation of the several grades becomes very conspicuous, as is evident from the following figures:

Clay Loam, Deer River, Lewis Co., N. Y.

| | Boiled One Hour. | | Not Boiled. | |
|---|---|---|---|---|
| | Berlin-Schöne. F. | Beaker. No. 51. | Beaker. No. 30. | Beaker. No. 31. |
| Above .25 | 22.39 | 20.26 | 20.92 | 19.91 |
| .25–.05 | 26.72 | 18.96 | 17.96 | 18.41 |
| .05–.01 | 21.75 | 23.70 | 25.26 | 26·94 |
| .01–.0 | 21.45 | 23.32 | 23.05 | 22.00 |
| Clay | | 5.10* | 3.55* | 4.75† |
| Loss by Ignition | 7.99 | 7.99 | 7.99 | 7.99 |
| | 100.30 | 99.33 | 98.73 | 100.00 |

The beaker analyses, Nos. 30 and 31, were made on this soil a year ago (report of this Station, 1886, p. 155), and are adduced for comparison with the recent analysis, No. 51. The soil here under consideration presents peculiar difficulties from the fact that it contains long-weathered fragments of clay-slate and of limestone and sandstone shales which break up on agitation, as in boiling or by pestling, into sand-grains of various grades, and into clay, so that any means which may be employed to disintegrate the existing clay, and detach it from the coarser matters, must pulverize the latter to some extent, and thus alter the mechanical composition of the soil. In my former paper, the effects of long boiling alone, and of boiling and churn-elutriation together, in reducing the coarser and increasing the finer sediments, are set forth. Here it will be seen on comparing the beaker analyses, that boiling for one hour seems to have had little effect on the two coarser grades of this loam, but has apparently diminished the 3d grade by about 2.4 per cent., and increased the 4th and 5th by nearly the same amount. But the beaker method, for the reason above stated, cannot be expected to give such closely corresponding results on this soil as to demonstrate by a single comparison the effect of boiling for one hour.

Comparing now the two analyses made on samples of the soil similarly prepared by boiling for one hour, we notice that the first two grades in the Schöne elutriation are 9.9 per cent. higher than by the beaker process, and the three finer grades are correspondingly lower.

The last elutriation, G, attempted by this method, was on a sample of the same brick clay, whose analysis, made with the unboiled earth, has been given already. For convenience of comparison the former analysis, D, is here copied, and the results of a correction of G, by the beaker method, are also stated.

* Determined directly.

† Clay and loss by difference.

BRICK CLAY, FROM NORTH HAVEN, CONN.

| | Berlin-Schöne Elutriation. | | | |
|---|---|---|---|---|
| | D. | G. | G 1. | No. 50. |
| | Not Boiled. | Boiled One Hour. | G, Corrected by Beaker Elutriation. | Direct Beaker Elutriation. |
| Above .25 | 1.02 | 1.02 | 1.02 | 1.02 |
| .25–.05 | 3.91 | 4.58 | .68 | .76 |
| .05–.01 | 29.63 | 29.94 | 22.90 | 20.95 |
| .01–.0<br>Clay | 58.58 | 57.14 | 68.08 | 71.01 |
| Loss by Ignition | 6.60 | 6.60 | 6.60 | 6.60 |
| | 99.74 | 99.28 | 99.28 | 100.34 |

The two analyses, D and G, agree very closely, the boiling of this clay for one hour in case of G, has had but little effect over the *preliminary* pestling applied to D, in increasing the per cent. of the finest at the expense of the coarser grades.

The composition of the several sediments from the Schöne–Orth apparatus in analysis G, as found by subjecting them separately to beaker elutriation is stated in the subjoined table. The up-and-down columns under G give the Schöne–Orth elutriation products and their sub-divisions effected by the beaker process. The cross-page figures under G, when added together, give the corrected analysis G 1.

NORTH HAVEN BRICK CLAY. BOILED ONE HOUR.

| | G. | | | | | G 1. |
|---|---|---|---|---|---|---|
| | Berlin-Schöne Method. | | | | | G, Corrected by Beaker Elutriation. |
| | Above .05 | .05–.01. | .01–.0. | Loss on Ignition. | Total. | |
| Siftings | 1.02 | | | | | 1.02 |
| .25–.05 | .68 | | | | | .68 |
| .05–.01 | 2.07 | 20.83 | | | | 22.90 |
| .01–.0 | .89 | 6.13 | 57.14 | | | 64.16 |
| Clay | .94 | 2.98 | | | | 3.92 |
| Loss by Ignition | | | | 6.60 | | 6.60 |
| Totals G | 5.60 | 29.94 | 57.14 | 6.60 | 99.28 | G. 1. 99.28 |

## SCHLŒSING'S METHOD.

According to Grandeau (Traité d'analyse des Matières Agricoles, 1887, p. 137), Schlœsing's method, "has the great advantage over all the other mechanical methods yet proposed, of making known the exact content of clay and sand in the soil. The very fine sand which closely resembles clay in its physical properties, and yet in chemical character is so entirely different is not here, as in all the mechanical analyses, confounded with the clay." By this method humus and carbonates are also determined.

In the analyses thus far given in this paper, the term " clay " has been applied to that portion of the soil which remained in suspension after allowing the water in which it had been diffused, the height of which was $200^{mm}$, to stand at rest for 24 hours (Hilgard's Conventional Method). By this means a product is obtained which consists of the greater part of the *true clay* contained in the soil, together with a considerable amount of very fine sand. The importance of separating this very fine sand from the true clay is obvious, for the chemical properties of the two are very unlike, and their influence on the physical character of the soil is different.

By *true clay* is here meant that material, mostly derived from the decomposition of feldspars and similar silicates, which is capable of uniting with a very considerable amount of water, and thus assuming a gelatinous condition in which it exerts a powerful binding action upon the particles of sand in the soil. To some extent, probably, this action is also exerted by iron and alumina hydroxides, as well as by colloid organic bodies. A relatively small amount of such clay is able to modify greatly the physical properties of a large amount of fine sand with which it is admixed, and to influence the agricultural character of the soil to a very marked degree.

Therefore, in view of the claims made for Schlœsing's method, the clay obtained by his process was carefully examined for sand.

Grandeau claims for Schlœsing's method more than Schlœsing himself. The latter in his *Contribution a l'Etude de la Chemie Agricole*, *Encyclopedie Chimique*, t. x., 1885, p. 86, remarks, " We have reckoned as clay all those elements which remain in suspension in water after a repose of 24 hours. In reality these elements contain a notable proportion of very fine sand which will be deposited in the course of time. In order that the liquid may be entirely rid of this sand it is necessary to wait several weeks or even months. Such a prolongation of the analysis is evidently inadmissible. I have proposed a rest of 24 hours, for the deposition of clay.

This is a conventional time, but this convention is justified by the fact that the sediment which we call clay presents, when it has a suitable degree of humidity, a cohesion and a plasticity in all respects analogous to that of the natural clays."

The method as described by Grandeau is briefly as follows:

1. Thorough mechanical subdivision of the sample by working under water with the fingers.
2. Further disintegration of the sample by solution of the lime salts in weak hydrochloric acid.
3. The solution of humus in dilute caustic potash or ammonia.
4. The separation of the humus and clay from the sand by means of repeated (up to 5 or 6) subsidences of 24 hours duration.
5. Separation of the clay and humus by precipitation of the clay by potassium chloride.
6. Determination of the amount of humus by precipitating its ammonia solution by acetic acid and lead acetate.
7. Separating the sand into several grades by sifting or levigation.

The directions in Grandeau's *Traité d'analyse des matières Agricoles*, p. 138, were carefully followed* and the results of the analyses are believed to show correctly how far the claims made by Grandeau for this method admit of vindication.

A calcareous brick clay and a prairie soil, rich in organic matter, were selected as suitable material for testing the method.

BRICK CLAY. NORTH HAVEN, CONN.

H.

*Schlœsing's Method.*

| | |
|---|---|
| Carbonate of lime | 4.20 |
| Sand | 64.91 |
| Clay | 22.65 |
| Humus | None |
| Loss on ignition | 6.60 |
| | 98.36 |

Before weighing "sand" in the above analysis obtained by following Grandeau's directions it was further examined as follows: In order to remove any still adhering clay it was pestled, suspended in water and allowed to settle for 24 hours when the water and suspended soil were poured off. The sediment thus obtained was repeatedly treated in the same manner until it subsided leaving the water perfectly clear. The clay and fine sand thus removed were suspended in water and allowed to stand for several days. The supernatant liquid was poured off and the sediment thoroughly pestled and treated in the same manner as the "sand" had been. This process was repeated until the clay-water deposited no particles of sand having a diameter greater than ·002$^{\text{mm}}$, and all the sand which had been deposited from the clay-water subsided leaving the water perfectly clear.

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* See also Contributions a l'Etude de la Chimie Agricole Par Th. Schlœsing, pp. 80-87, where a method for the "physical analysis" of soils is described, differing in various points from Grandeau's statements.

The sand and clay thus obtained were ignited and weighed and their sum represented the "sand" obtained according to Grandeau's directions.

This "clay" obtained according to Schlœsing's method was worked over in the same manner, in order to remove from it as far as possible the fine sand which the microscope showed it to contain. From this "clay" there was thus separated 8·99 per cent. of fine sand.

The following statement of the analysis shows the result of the foregoing treatment.

| | | H corrected. |
|---|---|---|
| Carbonate of lime | | 4.20 |
| Sand | Sand | 63.31 |
| | Clay | 1.60 |
| Clay | Sand | 8.99 |
| | Clay | 13.66 |
| Humus | | None |
| Loss on ignition | | 6.60 |
| | | 98.36 |

The clay thus separated still appeared to contain some very fine sand (below ·002$^{\text{mm}}$ diameter) from which it could not be freed by mechanical means.

This analysis is, in most respects, not comparable with those made on the same material by other methods, but as the corrected Berlin-Schöne elutriation, G. 1, made on a sample boiled one hour, gave but 3.92 per cent. of clay, it would appear that, of the 15.22 per cent. of clay here found, a considerable proportion must have resulted from the breaking up of concreted material by the treatment with hydrochloric acid.

With the prairie soil Schlœsing's method yielded the following results.

### PRAIRIE SOIL. MERCER CO., ILL.

J.

*Schlœsing's Method.*

| | |
|---|---|
| Carbonate of lime | .88 |
| Sand | 82.86 |
| Clay | 7.86 |
| Humus | 1.57 |
| Loss at 150° C. | 4.42 |
| | 97.59 |

The clay in this case contained very little sand which could be separated from it and in this respect the determination was satisfactory. The sand was elutriated by the beaker method and yielded a considerable amount of "clay" as determined according to Hilgard's conventional process. The complete elutriation of this sand may be compared with a similar elutriation of the same soil without previous treatment with acid and shows that the textural character of this soil is considerably changed by the action of dilute acids.

### PRAIRIE SOIL, MERCER CO., ILL.

| J. Schloesing's Method. | | XIV. Beaker Method. Schloesing's Sand. | | | | Original Soil. |
|---|---|---|---|---|---|---|
| | | | | Dried at 150° C. | Ignited. | Ignited. |
| Carbonate of Lime, | .88 | | | | | |
| Humus, | 1.57 | | | | | |
| Loss at 150° C., | 4.42 | | | | | |
| Sand, | 82.86 | Above .25$^{mm}$ | | .12 | .10 | .92 |
| | | .25–.05 | | 3.58 | 3.55 | 2.89 |
| | | .05–.01 | | 42.69 | 41.87 | 42.86 |
| | | .01–.0 | .01-0 | 23.66 | 20.47 | 31.44 |
| | | | Clay* | 12.81 | 10.14 | |
| Clay, | 7.86 | | | | | 7.40† |
| Loss on ignition, | | | | | | 14.49 |
| | 97.59 | | | | | 100.00 |

The figures indicate that the treatment with acid has disintegrated the particles of less than .01$^{mm}$ diameter so that one-third of this portion would appear as clay, according to the Hilgard method of estimating clay, which we have usually employed.

As to humus it may be noted that the loss in the analysis by Schloesing's method, viz: 2.41 per cent., plus loss at 150°—4.42 per cent. plus humus found—1.57, plus carbon dioxide ($\frac{44}{56}$ of .88=).69, amounts to 9.09 per cent., while the loss on ignition which represents humus, carbon dioxide (?) and water is 14.49 per cent. The 5.40 per cent. difference must evidently be, for the most part, humus which has escaped estimation by the Schloesing method, having been distributed among the sand and clay.

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* Determined by 24 hours subsidence. Chiefly fine sand.

† By difference.

Schloesing, in the *Encyclopédie Chimique*, directs to calcine the sand and thus to determine as "organic *debris*" the relatively bulky vegetable matters separated by sifting or found in the coarse sand. The humus in the clay is not determined nor taken account of in the method of "physical analysis" there described.

The humus determined in analysis J, is in fact humic acid, or that part of the dead vegetable matter, which, in the soil, exists chemically united to earthy and metallic bases in forms that are highly insoluble in water but are decomposed by hydrochloric acid.

The mechanical disintegration that has resulted from the chemical action of hydrochloric acid followed by that of an alkali, in case of this soil has been due to decomposition not only of carbonates, but also and perhaps in a greater degree, to that of humates.

## THE MECHANICAL DETERMINATION OF CLAY.

Schloesing's method for the separation of clay is essentially one of subsidence for 24 hours from a solution of 200 to 250$^{cc}$ volume, but of no specified height. Hilgard's conventional method requires the same time and a height of solution of 200$^{mm}$.

Such methods of separation assume, first, that most of the sand and second, that little of the clay shall settle within the fixed time. That both of these assumptions are fallacious, the following experiments show. The "clay" obtained by 24 hours subsidence from 30 grams of brick clay was suspended in four liters of distilled water and allowed to settle out completely, which required several days. The water was then decanted off so as to remove all soluble matters, the jar again filled with distilled water and the clay and fine sand allowed to settle again for several days. The upper three-quarters of the liquid were then decanted and made up to a volume of four liters, and this was allowed to stand several days when a considerable sediment had formed. A decantation was again made as before. The operations were repeated until the clay water had been so far freed from the clay as to become opalescent; then it first ceased to deposit any appreciable sediment. A microscopic examination of the several sediments thus collected showed them all to contain particles of sand. It appears, therefore, that only after the liquid containing the clay has become opalescent does it cease to deposit fine particles of sand as well as clay.

Furthermore, the character of the true clay itself is so changed under certain conditions that it loses the property of remaining in prolonged suspension in water.

A sample of clay which had been freed from particles of sand exceeding .005$^{mm}$ diameter was suspended in water and precipitated from it by freezing. It was then washed by decantation with alcohol and dried in the air. A portion of this clay was shaken up with water and allowed to stand a few hours, during which time the greater part of it had settled. After decanting off the water and suspended clay and repeating this process a few times a very considerable part of the clay was left which would subside completely through 100$^{mm}$ in a few hours. After standing under water for several months, only a small part of the clay had regained the quality of prolonged suspension. It was found, however, that if this clay were pestled this quality of prolonged suspension was restored to it to a very considerable degree.

It is evident, therefore, that conventional methods depending on simple subsidence can give no accurate results because the very varying amounts of finest sand and clay in different soils will yield very variable mixtures of the two when subjected to any simple course of treatment by elutriation and subsidence.

The method of persistent pestling and repeated subsidences and decantations continued until no further separation can be effected, although extremely tedious, is the only one which has as yet yielded even approximately good separations on any of the clayey soils I have hitherto examined.

A single subsidence of the clay water for 24 hours will free it from all particles of sand having a diameter greater than .005$^{mm}$, but in many cases a considerable amount of finer sand will remain in suspension for many hours or days.

On the other hand, the sediment formed during the twenty-four hours subsidence will not be free from clay, as may be easily seen by suspending it in water a second time and allowing it to stand again for twenty-four hours. Both Hilgard and Schloesing direct attention to these defects, but assume that they do not usually influence the results to a sufficient extent to deprive them of value. In many cases this is undoubtedly true, as for example, in such soils as that from the Garden of the Experiment Station in which there is but little clay and fine sand, but in soils of the opposite character as in the North Haven brick clay where exact separations are most desirable, a very considerable error is thus inevitably encountered.

### EFFECT OF BOILING ON THE TEXTURE OF CLAYEY SOILS.

Most investigators who have worked upon mechanical soil-analysis advise boiling with water in order to detach "clay" and "sand" from each other and make good separation of the several mechanical elements practicable or possible. In general, however, the instructions as to the time and manner of boiling are rather indefinite, and no proper research as to the effects of this treatment has been undertaken.

The practice of Prof. Hilgard, to boil 24 hours or even longer in case of adhesive clays, would appear to be objectionable in view of the dehydration and change of physical properties known to occur in case of many hydroxides, especially those of iron and aluminum, which occur or may occur in the soil. It is a familiar fact to the chemical student that the hydroxides above named and many other amorphous substances when precipitated from cold solutions are more bulky and less easily washed upon a filter than when thrown down hot. It is also well known that their properties are considerably changed by warming or boiling with water, and St. Gilles,* Davies† and Rodman‡ have shown that heating with water to boiling for some hours or days gradually converts the bulky brown-red ferric hydroxide, which when precipitated cold and air-dried for 18 days Carnelley and Walker§ found to contain 38 per cent. of water, into a much denser bright-red substance containing but two per cent. of water. St. Gilles has also observed the partial dehydration of aluminum hydroxide (from $Al_2O_3 . 5H_2O$ to $Al_2O_3, 2H_2O$) by prolonged boiling.

The hydrates of silica and the highly hydrated silicates are most probably affected in a similar manner, and if such be the case, boiling would evidently change the constitution of clay in a very essential degree.

The following experiments were undertaken to throw light upon this question:

10 grams of North Haven Brick Clay were boiled continuously for nine days in a glass flask of 1 liter capacity, with about $700^{cc}$ of distilled water and reflux condenser.

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* J. pr. Chem., lxvi, 141.

† Chem. Soc. J. [2], iv, 66.

‡ Am. J. Sci., xliv, 1867, p. 222.

§ Chem. Soc. J., Jan. 1888, pp. 76.

15 grams were boiled in the same manner for eight and one half days. When the boiling was concluded the soil was found to have assumed a granular condition, the clay and fine sand being collected into a mass of small grains resembling coarse sand which settled rapidly. One portion thus boiled was elutriated by the Beaker method, the other by Hilgard's. The pestle was not used on either of those portions as it was desired to determine simply the effect of prolonged boiling. The separations thus accomplished are here compared with the elutriations of the same soil boiled 23 hours and of the pestled but unboiled soil.

BRICK CLAY, NORTH HAVEN.

*Effect of long Boiling (in glass).*

| | Hilgard Elutriation. | | Beaker Elutriation. | |
|---|---|---|---|---|
| | Not pestled. | | | Pestled. |
| | Boiled 23 hrs.<br>XII. | Boiled 9 days.<br>XVI. | Boiled 8½ days.<br>No. 40. | Not boiled.<br>No. 27. |
| Sifted | 3.36 | 3.24 | 3.63 | 3.49 |
| .25–.05 | 1.21 | 1.11 | 1.91 | 1.29 |
| .05–.01 | 28.27 | 33.04 | 33.61 | 27.02 |
| .01–0 | 56.29 | 48.85 | 54.78 | 52.21 |
| Clay | 4.92 | 3.05 | 1.97 | 10.15 |
| Loss on ignition | 5.95 | 5.95 | 5.95 | 5.95 |
| | 100.00 | 95.24 | 101.85 | 100.11 |

Here it is observed that the 8–9 day's boiling diminished the clay as determined by Hilgard's conventional method by 7–8 per cent., increasing the "dust" by 2–3 per cent. and the "silt" by about 6 per cent.

Under the microscope small, rounded, opaque, brown granules were seen in large numbers, which when pressed under the cover-glass broke up into a multitude of very fine particles.

Unfortunately the sample was exhausted by these analyses and the experiment could not be repeated so as to correct the considerable error indicated by the loss in XVI.

From these experiments it would appear to be conclusively proved that too long boiling precipitates clay and thereby defeats the very object of the operation.

In these experiments the time of boiling was prolonged in order to bring out unmistakably the effects of this operation. If ebullition for 8 or 9 days reduces "clay" from 10 to 2–3 per cent., increasing the .05–.01$^{mm}$ grades by 6 per cent., it is evident that boiling for one day or a shorter time becomes a questionable treatment. In the analyses made by the use of Hilgard's churn elutriator, published in my former paper, it is easy to trace the effect of boiling. This very Brick Clay boiled for 23 hours is shown by analysis XII above quoted, either to have come short of sufficient disintegration in the .05–0 sediments, or if sufficiently disintegrated, to have suffered subsequent precipitation of half of the clay with those sediments.

The comparative analyses of Prairie Soil given in my former paper lead to the same alternative. The Hilgard elutriation, after 23 hours boiling, XIV (Report of this Station for 1886, p. 157) yielded less of clay by 2 per cent., less of .01–$0^{mm}$ by nearly 5 per cent., and more of the two coarser grades by 7 per cent. than the Beaker elutriation on unboiled soil.

Whether this precipitation on boiling is simply due to dehydration by heat or is partly or wholly attributable to the action of salts extracted from the clay or from the glass of the vessel, further experiments in metallic vessels, which are already in progress, may decide.

When the clay has once been converted into the "granular" condition considerable difficulty is experienced in restoring it to the state in which it is capable of prolonged suspension in water.

The results of the studies herewith reported may be summed up as follows :—

1. The Berlin-Schöne method of elutriation gives fairly correct separations with sandy soils containing little clay or matters finer than $.01^{mm}$, but on fine-textured soils, as loams rich in humus and clays, it gives results which are grossly inaccurate, the error on single grades amounting to 8–14 per cent.

2. In respect to rapidity, economy of time and ease of operating, the Schöne elutriation has no advantage over the Beaker method.

3. Schlöesing's method on its mechanical side makes no satisfactory separations, and the chemical treatment it employs is liable seriously to alter the texture of the soil.

4. The determination of "clay" by a single subsidence from any conventional volume or depth of water, or for any conventional time, is not a process certain to effect even a roughly approximate separation of the finest quartz grains from true clay.

5. Boiling with water must be rejected as a treatment preliminary to mechanical analysis, because it not only abrades and reduces the coarser sediments, but dehydrates and coagulates the true clay and thus essentially alters the texture and grain of the soil.

In a paper "On the Methods of Mechanical Soil Analysis," published in the "Proceedings of the Eighth Annual Meeting of the Society for the Promotion of Agricultural Science, 1887, pp. 48–50, Prof. E. W. Hilgard states his objections to "the subsidence method or 'beaker elutriation,'" and explains the reasons which formerly induced him "to reject this same method." Prof. Hilgard further says, "After obtaining an insight into the grave difficulties involved in the hydraulic process my first thought was to avoid them by using the obvious and simple method of subsidence, and I thus went very fully over the ground covered by Dr. Osborne's work," and again, "So far the only difference between Dr. Osborne's plan and mine is that he proposes to treat, also, the larger sized sediments ($>$·28$^{mm}$ hyd. value) by the subsidence method.

But Prof. Hilgard has overlooked the fact that the older "subsidence methods" differ essentially from the process which I have proposed to distinguish as "beaker-elutriation" in one very important and characteristic particular.

Prof. Hilgard says that his objection to the "subsidence method" is "simply that life seems to me too short to be occupied in painfully watching the second-hand of the watch up to the decisive moment when a short paroxysm of precipitate activity ensues, to be again succeeded by a period of enforced idleness and patience-trying watchfulness."

In my first paper (Report of this Station for 1886, p. 142), I stated nearly at the outset that "it shortly became evident that nothing is to be gained by limiting sedimentation arbitrarily to any particular intervals of time and space," and I would repeat that my process does not, as Prof. Hilgard appears to suppose, require any "close observance of the times corresponding to grain sizes," but that the eye and the micrometer alone decide the results of separations and indicate the times and the number of the subsidences, which are simply repeated until a desired result is attained and all with as much freedom to the operator as is permissible in carrying on hydraulic elutriation, or the ordinary work of the laboratory. In fact, if I am able to judge impartially, the actual consumption of time and nerve in hydraulic elutriation, including the preliminary boiling, the handling of large volumes of distilled water, and of clay-water, and the use and care of delicate apparatus, is no less than in beaker elutriation.

# THE STATION FORAGE GARDEN.

How to improve Connecticut grass-lands so as to make them more productive and also more permanent (wherever that is desirable), are questions of the first importance. To answer these questions we need for one thing, to know more about the hardy grasses and forage-plants which grow in our state with less care than others and no expense for seeding; their habits of growth, seed production, fitness for meadow and pasture on different soils, feeding value, rooting peculiarities, growth with other varieties, possible improvement by cultivation or by selection of seed, the effect of different fertilizers, etc. We need, also, to secure a more general and a closer observation of the appearance and behavior of all our useful grasses, so that they may be known by botanists as well as by farmers, at sight, through the spring, summer and fall. We need to have names for them which shall pass current every where, free from all confusion; because without names there can be no discussion of grass away from the grasses themselves. Only by a general improvement in these respects can the literature of our agricultural grasses become satisfactory or as widely useful as the welfare of the State demands.

Botanists at present have for their ready information books and collections of carefully dried plants usually gathered when in flower or fruit, each labeled with its scientific name. To identify a specimen botanists require to see it either in flower or fruit. Agricultural botany needs to go further than this; to read the sod like a book and identify with certainty the common grasses at all stages of growth from spring to fall. The botanist's herbarium is not enough for this. We must have the planted as well as printed page. There are needed for reference, as keys to our door-yards and farms, collections of growing grasses, to show as the season advances, their foliage, flowers, seed and general appearance. These when properly labeled, will enable a good observer without any special knowledge of botany to name almost any grass which grows in this State. Such a collection has been gathered at this Station during the last eighteen months to serve as a starting point, we hope, for other collections throughout the

State. Many of the difficulties in the way of starting, especially in procuring seeds and plants, have been overcome here and need not be encountered by others. It is hoped that many farmers will join the Station in its closer study of forage plants. To learn the names of a considerable collection in the home garden or at large on the farm can scarcely tax the memory more than a teacher is taxed in learning the names of scholars the first week of school.

The Station was fortunate at the outset in having the services of Mr. James B. Olcott, of South Manchester. The success of the undertaking has been largely due to Mr. Olcott's special knowledge, to his energy and persistence in securing specimens of seed and growing plants, and to his advice and personal services in the garden itself.

Seeds of grasses for the garden have been collected where possible, in and about New Haven by ourselves. Messrs. Vilmorin, Andrieux & Co., of Paris, Peter Henderson & Co., of New York, and R. D. Hawley, of Hartford, kindly supplied us with seeds ordered from them, without charge. From J. J. Wolfenden of New Berne, N. C., we received a package of seeds of the Cow Pea. A collection of sods of western grasses was kindly sent to us by A. Gilchrist, Esq., of Cheyenne, Wyoming. Prof. E. M. Shelton of the Kansas Agricultural College, and Carlos Reese, Esq., of Marion, Ala., both favored us with seed and sod or roots of Texas blue-glass [*Poa arachnifera*]. To the New York Experiment Station we are also indebted for a gift of seed. To Dr. Vasey, Botanist of the U. S. Department of Agriculture, our special thanks are due for both seeds and sods of a number of western and Mexican grasses from the Department gardens as well as for frequent favors in identifying species.

The U. S. Department of Agriculture also supplied us with seeds of a considerable number of forage plants, most of which proved very satisfactory.

Seeds of the grasses were planted in drills, seven feet long and from 18 to 24 inches apart, and were usually covered half an inch deep and the earth was moderately compacted over them. Those which it seemed desirable to have also in sward, were sown in plats 7 feet long by 5 feet wide, raked in and rolled with a light roller.

If the weather was dry after planting they were lightly mulched with corn stalks, salt marsh hay or tobacco stems. The tenderer grasses were also mulched lightly late in the winter when the snow was going, to prevent the tearing of their roots by the frequent thawing and freezing. In November of 1886, 45 sods collected by Mr. Olcott, in the neighborhood of Hartford, all of them correctly labeled, were received for the garden. These, with one or two exceptions, did not suffer by transplanting but furnished more satisfactory specimens the following summer than any from the fall sowing of seeds. Others have from time to time sent in sods and seeds to be tested in the garden. During the Spring of 1887, Mr. Olcott, at our request, visited Rhode Island and made a study of "Rhode Island Bent" both in the seed pastures and meadows and in the seed market, sending specimens of the trade seed and of the sods from many different places, for observation in our forage garden. He subsequently made a partial survey of this State with the same objects in view. A paper by Mr. Olcott, on Fine *versus* Coarse Agrostis, will be found in the following pages.

By constant care each drill and plat has been kept entirely clean of all weeds or grasses other than the one specially planted. A special set of thrust and bayonet hoes made for us by the Collins Co. from Mr. Olcott's models, has alone made this possible with the limited time that could be given to the garden. Our experience proves that for the greatest convenience in weeding, the drills should have been one foot shorter and the plats one or two feet narrower.

The total number of sods now in the garden, many of them duplicates of the same species, is 650, of drills there are 163 and of plats 56.

The garden contains 81 out of the 120 species of grasses which grow without care in this State, and besides, some thirty species of grasses which do not occur wild in this State. Besides grasses, there are grown clovers, vetches and lupines as well as some of the more interesting sedges, which furnish a part of our hay and grazing. All these kinds of plants are proper subjects of recognition and study, whether they prove useful or not. Thus far the work in the forage garden has been chiefly devoted to securing specimens of grasses and seed true to name. Certain experiments have been commenced but results are not yet ready for discussion.

We only note here one or two observations made incidentally in our collection of specimens and seed. Attention is also called in this connection to the analyses of certain grasses given on page 100. To ascertain the present state of the seed market in Fine Bent, Rhode Island Bent seed was ordered by us from 10 of the prominent seedsmen in New York, Philadelphia and Boston. Six lots only were obtained, four of the firms not being able to supply it. These lots were sown in plats rather late in the season and blossomed very sparingly. It was evident however that only two of them contained any considerable quantity of "Fine Bent," the others were chiefly "Coarse Bent"—the ordinary trade red-top.

Of the samples of wheat sent by the U. S. Department of Agriculture, those bearing the following labels did well.

Martins' Amber.
Four-rowed Sheriff.
Diehl's Mediterranean.
McGee White.
Raub's Black Prolific.
German Emperor.
Fulcaster.

The last two varieties made the heaviest growth. Genoese and White Crimean winter-killed badly.

Indian and Extra Early Oakley sprouted very feebly.

A sample bought for *Festuca pratensis*, Meadow Fescue, proved to be *Lolium perenne*, or English Rye Grass with perhaps a little Italian Rye Grass.

A sample of *Anthoxanthum odoratum*, or Sweet Vernal grass proved to be Var. *Puelii* which is an annual plant much inferior to the perennial Sweet Vernal. It is extensively sold for the more valuable variety.

A sample of "Superior Rhode Island Bent" proved to be chiefly tall Red-top, not Rhode Island Bent, or fine Red-Top at all. The same was true of a sample of trade "*Agrostis canina.*"

A sample bought for *Avena elatior* or tall Oat grass, proved to be a mixture of *Bromus secalinus* or Cheat or Chess, *Dactylis glomerata* or Orchard grass, much *Lolium perenne* or English Rye grass and some *Avena elatior.*

A sample bought for *Poa annua* or Annual Spear grass proved to be another *Poa*, which has not yet been identified.

Another sample bought for Sweet Vernal grass contained a large quantity of seed of a handsome, but agriculturally worthless, annual grass, *Apera spica-venti.*

A sample of "Hard Fescue," *Festuca duriuscula*, proved to be about half Hard Fescue and half Sheep's Fescue.

The Southern Cow Pea has grown very vigorously in the garden, furnishing a large amount of forage and ripening its seed before frost.

It is noteworthy that *Phalaris arundinacea* or Reed Canary-grass, the *Glycerias* and certain sedges, notably *Carex vulgaris*, which are wet-land or marsh grasses, made excellent growth in our garden soil. It may be that these and other grasses if freed from competition with other plants or from the grazing of cattle would thrive as well in dry as in wet places.

From these notes it is evident that the trade in pure seed is not in a satisfactory state and that fresh seed true to name for a garden like ours must be collected by those in charge, for it cannot be bought with any certainty as to quality. This fact was fully appreciated at the outset and we have only bought seed when it was impossible to get it otherwise. We have now gathered from our own garden, as the list on page 173 shows, small quantities of seed from many species of grass which is true to name. The Station will be glad to receive from any source seeds or sods of grasses not in this list, and to exchange for them any sod or seed which it has in surplus. To the extent of its ability it will aid any institution which has such work in prospect. It will also continue to receive from citizens of Connecticut plants for identification as explained in Bulletin No. 91.

The Station is also always prepared to examine for farmers seeds of grasses or of vegetables with reference to their purity and vitality as explained in the Report for 1883, page 105.

How the practical information which the Station garden offers can best be distributed through the state is an important question. Personal visits to the garden will certainly be profitable alike to the visitor and to those in charge of it, favoring an exchange of knowledge on the subject. The Station can supply to a limited number of Granges, Farmers' Clubs or Schools small collections of named grass-seeds for planting if they are desired. Should sufficient interest be awakened it could perhaps arrange to send by mail whole plants for inspection and study as they come into bloom through the season. The recommendation of the Dairymen's Association made at its recent meeting that Agricultural Societies offer small premiums for the best collections of named grasses is a step in the right direction.

The following pages of explanations are here repeated, with some minor changes, from Bulletin No. 93 of this Station.

### ON THE CLASSIFICATION AND NAMING OF PLANTS.

To aid in understanding the plan by which men of science have classified and named grasses and other plants, the following explanations are offered.

It is evident at the outset that in order to describe a plant exactly words must be used which have as far as possible a strictly definite and unmistakable meaning. Botanists acting on this principle have adopted certain words which they employ in their classification of plants. Such words are *variety*, *species*, *genus*, and *family*. In the following pages we have endeavored to give the sense in which the botanist uses some of the more important of these terms, believing that the farmer also will find great benefit in their scientific use.

*A Species* is intended to include all individual plants which are very closely alike in form, structure and manner of growth, and which steadily reproduce plants which are like the parents in all these particulars. For instance there is a species called the white oak (*Quercus alba*). The leaves of every white oak tree have a general oblong or egg shape, but are cut into 3 to 9 oblong or linear lobes, having no pointed tips, smooth, of a bright green color above and pale below. All white oaks bear their acorns in the fall, on wood of the same year's growth, the cups of these acorns are rough, hemispherical, and much shorter than the acorns themselves, which are oblong. No other oak but the white oak has all these peculiarities of structure and growth. The white oak cannot be confounded by any one who knows these facts, with the red oak, or the shrub oak, or the swamp white oak which are three distinct species. Moreover from the acorns of the white oak only a white oak will grow, never a swamp white oak, shrub oak or red oak. The white oaks are related by a kind of common origin which the other oaks do not have in common with them. Another distinguishing mark of a species is the power of continued reproduction between individuals belonging to it. All white oaks cross-fertilize, i. e., the pollen from one white oak tree will fertilize the pistillate flower of any other white oak tree, whereas it would not fertilize the pistillate flower of another perfectly distinct species of oak. Among grasses, Hungarian grass (*Setaria Italica*) is one species and the yellow fox-tail (*Setaria glauca*) is another and related species. The differences between these two [species differences or *specific* differences] are well known to many farmers.

*Varieties.*—Individuals of the same species while very closely alike differ from each other more or less. Circumstances of soil, climate, etc., increase these differences and varieties originate when such differences assume a *comparative permanence and fixity.* But as external conditions cause variations away from any particular representative of a species, so they may cause variation back again to the original, and although variation may take a seemingly wide range, its bounds are fixed and do not touch specific characters. Among plants varieties may often be perpetuated by the seed. This is true of our cereals and leguminous crops, which reproduce their kind with striking regularity. The Tom Thumb, Marrowfat and Champion of England peas, for instance, are all varieties of one species which are reproduced true to the seed. In case of certain other plants, particularly those in which there is abundant chance for a mixing of pollen, favorite varieties cannot be, or are not, certainly reproduced unalterably by the seed.

Red-top [*Agrostis vulgaris*] has two agricultural varieties as distinct as the Tom Thumb and the Champion of England Pea: Tall Red-top which grows 24–30 inches high, blooms a week later than the other variety and has a coarser foliage; Fine Red-top or, Rhode Island Bent, which grows 12–15 inches high, blooms earlier and has a much finer foliage. Both are reproduced true from seed. We also find forms intermediate between these two which evidently belong to the same species although they cannot always be classed with one variety rather than the other.

*Genus.*—All the different species of oaks have a general family resemblance noticeable by any one, and certain common characters, chiefly in their flower and fruit, which distinguish them from all other trees. This group of closely allied species makes a *genus* [plural, *genera*]. So we have the oak genus [*Quercus*] including the white oak, the chestnut oak, red oak, etc. In like manner we have the Red-top genus [*Agrostis*], which includes our common varieties of Red-top, already spoken of, besides fiorin [*Agrostis alba*], about which English grass books say so much, Brown Bent or Dog's Bent [*Agrostis canina*], and the Thin grass [*Agrostis perennans*], which grows in shady places, etc. The Timothy genus [*Phleum*] includes both our eastern

Timothy [*Phleum pratense*], or English grass and the Mountain Timothy of the west [*Phleum alpinum*].

*Families.*—The genera themselves are grouped into families. Thus the oaks, chestnuts, beeches, hazels and hornbeams, all belong in one family, the *Cupuliferæ* or cup bearers, so called because each fruit, a nut, is borne in a cup shaped receptacle. So too the genera *Agrostis* and *Phleum*, and all other grasses belong in the one family of *Gramineæ*, whose aspect and characters are well known.

### NAMES OF GRASSES.

In order to speak or write intelligibly of plants it is necessary to have a name for each which shall be commonly and perfectly understood and which shall apply to one species and only one. Following the method first proposed by Linnæus, "the father of botany," it was long ago agreed to give to each species of plants two names, one, the first, being the name of its genus, the second the species name; and in order that the same name might be used by botanists of all lands the Latin form was used, that being the nearest approach to a universal language. The name is given by the botanist who first identifies or classifies the plant and his name or initials are often put after the name which he gives. *Quercus*, as we have already seen, is the name of the oak genus, as distinguished from the hickory or chestnut genus, *alba* is the species or specific name and distinguishes the white oak from the red oak, live oak, post oak, etc. While the name white oak is recognized only where the English language is spoken and even there is liable to be confounded with the swamp white oak, which is a very distinct species, the name *Quercus alba* is understood by botanists all over the world.' But it sometimes happens that after a plant supposed to be new has been named, it appears that it had been previously described and differently named by some one else. In such cases, to avoid all confusion, the invariable rule is to use the name first given.

These then are the names found in our standard botanical books. The objection to their common use is that they are in a strange language and sometimes long. They are hardly stranger, however, than "nitrogen," "available phosphoric acid," and "actual potash" were to most farmers a few years ago. The advantage of these names is that they avoid confusion and make intelligible our discussion of botanical matters. To illustrate: "Poverty grass" is a common grass, frequently spoken of among farmers, but this name is commonly applied to at least two very distinct species, viz: *Danthonia spicata*, which grows only in a very poor soil and is of no value as forage, and *Andropogon scoparius*, which also grows on poor sandy soil, but in some places makes valuable feed. This last is also called "broom sedge," whereas it is a grass and not at all a sedge. "Blue Stem" and "Blue Bent" are names of one of our best native grasses, *Andropogon provincialis;* "Blue Joint," which is dangerously like "Blue Stem," is the name of a grass very different from the last, viz: *Deyeuxia Canadensis.* "Wood grass" is applied to *Chrysopogon nutans*, a coarse but good forage grass, and to *Muhlenbergia Mexicana*, which is totally different in appearance and value. Now "Poverty grass," "Blue Stem," "Blue Bent" and "Wood grass," are indefinite terms, but *Danthonia spicata*, *Andropogon provincialis*, *Muhlenbergia Mexicana*, etc., can never be confused, since these names are used by all botanists and in their writings the peculiarities of these grasses are accurately and fully described. In the list of names of grasses on page 174 of this Report will be found both the botanical and colloquial names of the commonest grasses, which will illustrate these points and will also explain the meaning of some botanical names.

We believe that a better knowledge of our Connecticut grasses, of their habits of growth and forage value, is one great need of our agriculture. But the first step toward getting and spreading that knowledge must be to have names for the more useful ones, which shall be so definite that no one will misunderstand them, and which shall not be so difficult or uncouth that intelligent men will not use them. At present we have no such names *in common use* among us. There are not more than three or four grasses in this State whose common English names are generally used throughout the State without confusing synonyms which are also applied to other grasses. These are Timothy, Red-top, June-grass and Orchard-grass. Even Red-top applies to two grasses agriculturally distinct, and June-grass is a name quite generally used without the knowledge that it is the same as Kentucky Blue-grass. Yet there are at least eleven important meadow grasses which are mowed in large quantity every year in the State, and at least six others which are common and valuable pasture grasses, to say nothing of a number of less common but very useful ones and of the sedges, some of which are valuable. We have then on the one hand Latin botanical names which are tolerably free from confusion, and on the other hand common English names which are very much confused and indefinite. The former are not familiar and are, perhaps, harder to learn than the latter. The question is, can they and will they be learned by intelligent farmers? If not, can English names be agreed upon for all our common grasses which shall be as definite and free from confusion as the botanical names, and can they be brought into common use? A revision of the grass nomenclature now in common use, like the revision of pomological names which is at present going on, is very desirable. Till it is accomplished, the Station, to be accurate and clear, can only use the botanical names, supplying where possible the best common names, as on page 174 of this Report.

The following list includes all grasses which have grown in the Station Forage-garden during the present season. The annual grasses of course, at this time, are dead, and have been sown again for next year. An asterisk (*) before the name of a grass denotes that we have at our disposal, for exchange, a few young plants or sods; a dagger (†) in the same position denotes that we have seed for exchange. The quantity which we propose to exchange will be but quite small, in most cases only sufficient for a drill seven or eight feet long; enough, however, to show the characters of the grass, and to yield seed next year for a larger sowing, if that is desired. The seed we believe to be sound, strictly pure and true to name, most of it gathered in this garden and by our own hands.

# GRASSES IN THE GARDEN OF THE STATION.

Agropyrum caninum. [*Triticum caninum of Gray's botany.*]
 divergens.
† glaucum.
† repens. [*Triticum repens of Gray's botany.*]
† tenerum.
Agrostis exarata.
*† perennans.
† scabra.
*† vulgaris, var. major.
*† vulgaris, var. minor.
*† var. alba ?
*†Alopecurus pratensis.
†Andropogon dissitiflorus. [*A. Virginicus of Gray's botany.*]
† provincialis, [*A. furcatus of Gray's botany.*]
*† scoparius.
†Anthoxanthum odoratum.
† var. Puelii.
†Apera spica-venti.
†Aristida purpurascens.
 purpurea.
*†Arrhenatherum avenaceum.
*†Asprella hystrix. [*Gymnostichum hystrix, of Gray's botany.*]
*†Avena flavescens.
†Boutiloua olygostachya.
*†Bromus brizaeformis.
† ciliatus.
* inermis.
* pratensis.
*† Schraederi.
*† secalinus.
† segetum.
*† tectorum.
[Carex stricta.]
[ tentaculata.]
* [ vulgaris.]
†Cenchrus tribuloides.
†Chrysopogon nutans, [*Sorghum nutans of Gray's botany.*]
†Cinna arundinacea.
Cynosurus cristatus.
[Cyperus Michauxianus.]
*†Dactylis glomerata.
*†Danthonia spicata.
Deschampsia caespitosa.
† flexuosa.
† pulchella ?
†Deyeuxia Canadensis. [*Calamagrostis Canadensis of Gray's botany.*]
Diplachne fascicularis, [*Leptochloa fascicularis of Gray's botany.*]
Eatonia obtusata.
Eleusine Indica.
Elymus Canadensis.
*† Virginicus.
†Eragrostis capillaris.
*† pectinacea.
† pilosa.
† poeoides, var. megastachya.
Erianthus Ravennae.
Eulalia Japonica.
 var. variegata.
*Festuca duriuscula.
† pratensis.
 heterophylla.
 nutans.
* ovina.
* var. tenuifolia.
 var. rubra.
† tenella.
†Glyceria aquatica. var. Americana.
† Canadensis.
 nervata.
†Holcus lanatus.
Hordeum jubatum.
Leersia oryzoides.
 Virginicus.

***†Lolium perenne.**
***† var. Italicum.**
*** var. tenue.**
**Muhlenbergia capillaris.**
**† diffusa.**
***† Mexicana.**
**Willdenovii.**
**†Panicum agrostoides.**
**† capillare.**
**clandestinum.**
**† crus-galli.**
**† var. hispidum.**
**dichotomum.**
**filiforme.**
**glabrum.**
**† latifolium.**
**† miliaceum.**
**proliferum.**
**† sanguinale.**
**† virgatum.**
**Paspalum setaceum.**
***Phalaris arundinacea.**
***†Phleum pratense.**
**Phragmites communis.**
**Poa annua.**
*** arachnifera.**
***† compressa.**
**Nevadensis.**
*** pratensis.**
***† serotina.**
**trivialis.**
**Reana luxurians.**
**†Setaria glauca.**
**† verticillata.**
**† viridis.**
**Sorghum halapense.**
**Spartina cynosuroides.**
**Sporobolus depauperatus.**
**† heterolepis.**
**Stipa pennata.**
**spartea.**
***†Triodia seslerioides.** [*Tricuspis seslerioides, of Gray's botany.*]
***Vilfa vaginaeflora.**
**aspera.**

Since these botanical names are not familiar to many, there follow here by way of explanation, the botanical names of the more common agricultural grasses, their pronunciation indicated by accents, and their derivation given as far as that is possible. With each are given, in lighter type, the colloquial or provincial names by which they are sometimes known. As yet we have no really common names.

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## BOTANICAL AND COLLOQUIAL NAMES OF GRASSES.

**Agropyrum répens**, formerly called *Triticum repens*, [*Agropyrus* = field wheat, *repens* = creeping.] Couch-, Quitch-, or Quick-grass, Quack, Twitch- or Dog's-grass, Dutch-grass, Durfa, Devil's-grass. Grows through potato tubers!

**Agróstis scábra**, [*scabra* = rough.] Hair-grass.

**Agróstis vulgáris.** [*Agrostis* = a field, the place of growth, *vulgaris* = common or ordinary; i. e. common field grass.] Red-top, Fine-top, Furze-top, Burden-grass (from its fleece-like burden rolling from the scythe) Bent, Fine Bent, English grass, Rhode Island Bent. These names all apply in different sections to a variety that is twelve to fifteen inches high and blooms a little earlier than another taller variety, which is Tall Red-top. Tall Red-top grows twenty-four to thirty inches high, and is much sown with timothy and clover in short rotation.

The seed of this is now chiefly grown far west. That of the other for lawns should be saved from clean turf in the east as of well-swarded sheep pastures, with no mixture of other grasses.

**Alopecúrus praténsis.** [*Alopecurus* = a fox tail, *pratensis* = of the meadow.] Meadow Fox tail, "Mountain Timothy" of Montana. Blooms earlier, taller, and with a shorter head than Timothy, moreover the leaves and stems are of a darker and richer green.

**Andropógon provinciális.** [*Andropogon* = bearded man, the staminate or male flowers often being bearded, *provincialis* = of a province.] Thatch, Finger-spiked Broom-grass, Blue Stem, Blue Bent of Connecticut River meadows.

**Andropógon scopárius.** {*scoparius*, Latin = sweeping.] Wood-grass. Broom-grass, Broom sedge. The grass of the Wallingford plains.

**Andropógon dissitiflórus.** Broom sedge. Not a sedge but a grass.

The Andropogons start late in spring and stop growing with cool weather.

**Anthoxánthum odorátum.** [*Anthoxanthum* = flower of flowers, *odoratum* = odorous.] Sweet Vernal-grass, Sweet-scented Spring-grass. Has bitter foliage but scents the hay.

**Arrhenathèrum avenàceum.** [*Arrhenatherum* = awned stamen, *avenaceum* = like oats.] Tall Oat-grass. The foliage has a distinctly bitter taste. Early and hardy.

**Chrysopógon nútans.** [*Chrysopogon* = golden bearded, *nutans* = nodding.] *Sorghum nutans.* Indian-grass, Wood-grass. Starts late in spring and stops growing with cool weather.

**Cínna arundinácea.** [*Cinna*, name unexplained, *arundinacea* = reed-like.] Wood Reed-grass.

**Dáctylis glomeráta.** [*Dactylis* = finger's breadth, alluding to the size of the clusters, *glomerata* = crowded together, in allusion to the flower clusters.] Orchard-grass, Cock's-foot-grass, Rough Cock's-foot-grass. Young stems flat at base in fall and spring, and so quite distinct from Timothy. Almost evergreen.

**Danthónia spicáta.** [*Danthonia*, from Danthoine, a French botanist, *spicata* = spiked.] Poverty-grass. Oat-grass. Spiked wild Oat-grass. White Top.

**Deyeúxia Canadénsis.** Blue Joint, Small Reed-grass. Grows in wet places and makes good hay.

**Festúca ovína.** [*Festuca*, the old Latin name for it, *ovina* = belonging to sheep.] Sheep's Fescue. Makes the finest, close sward alone and without manure on suitable soils. Seed in market seems to grow plants which are seedy and bunchy. Remedy may be a return to old pasture seed.

**Festúca praténsis.** [*pratensis* = of the meadow.] Meadow Fescue. In Conn. we have very little or none of this species growing tall enough to answer the descriptions of *elatior* by English writers. Excellent for rich permanent meadow or pasture.

**Glycéria Canadénsis.** [*Glyceria* = sweet, in allusion to taste of the grain, *Canadensis* = Canadian.] Rattlesnake-grass, Tall Quaking-grass. Grows in wet places. Cattle eat it greedily.

**Glycéria nerváta.** [*nervata* = nerved.] Nerved Meadow-grass, Nerved Manna-grass, Fowl Meadow-grass. This name is properly applied only to *Poa serotina.* Makes good hay on wet land.

**Glycéria aquática.** [*aquatica* = aquatic.] Reed Meadow-grass, White Spear-grass. A wet meadow grass. Quite sweet at base of stalk.

**Hólcus lanátus.** [*Holcus* = attractive, *lanatus* = wooly.] Velvet-grass, Meadow Soft-grass, Velvet Mesquite-grass. Called "Calf-Kill" in Rhode Island from the rather dry and wooly, innutritious character of the forage, probably.

**Leérsia oryzoídes.** [*Leersia*, named for Leers, a German botanist, *oryzoides* = like rice.] Rice Cut-grass. Grows in wet places and in rich flowed land gives heavy crops. Fodder value not well known. Rough as a cow's tongue.

**Muhlenbérgia Mexicána.** [*Muhlenbergia*, named for Muhlenberg, an American botanist, *Mexicana* = Mexican.] Drop seed. Wood-grass.

**Muhlenbérgia diffúsa.** [*diffusa* = spreading, diffuse.] Drop-seed. Nimble Will.

**Pánicum sanguinále.** [*Panicum*, an ancient Latin name for millet supposed to come from the word meaning bread, *sanguinale* = bloody.] Common Crab or Finger-grass. A very common annual weed under the lawn-mower.

**Pánicum agrostoídes.** [*Agrostoides* = like an *agrostis*.] Red-top Panic.

**Pánicum virgátum.** [*virgatum* = made of twigs or osiers.] Tall Panic-grass, Switch-grass. Long-panicled Panic-grass, Black Bent of Connecticut River meadows. This species like *Andropogon provincialis* and *Chrysopogon nutans* has its foliage injured by frost.

These Panicums like the Andropogons are warm weather grasses.

**Phléum praténse.** [*Phleum*, an ancient Greek name, *pratense* = of the meadow.] Timothy, Herd's grass in New England and New York.

**Póa ánnua.** [*Poa*, ancient name for grass or fodder, *annua* = annual.] Low Spear-grass, Annual Spear-grass, Annual Meadow-grass, Goose-grass. Good for rich lawns.

**Póa compréssa.** [*compressa* = pressed together, flat.] Old English Blue-grass, Wire-grass, Flat-stalked Meadow-grass. Will grow in very dry places, sterile railway banks, etc. Endures the closest grazing.

**Póa serótina.** [*serotina* = late ripe or backward.] Fowl Meadow-grass, Late Flowering Meadow-grass, False Red-top. Fine hay on wet land.

**Póa praténsis.** [*pratensis* = of the meadow.] Green or common Meadow-grass, June-grass, Kentucky Blue-grass, Spear-grass. Smooth-stalked Meadow-grass. Excellent for parks and cemeteries. Seed-stalk frequently blasted early in the season. Very common all over Connecticut.

**Póa triviális.** [*trivialis* = common-place.] Rough-stalked Meadow-grass, Common Meadow-grass. It is scarce and uncommon in meadows except they are old, rich and moist or shaded. Loudon says this, with *P. annua*, are almost the only grasses that will grow in shaded and enclosed places in towns. *Festuca ovina* may have been in Loudon's mind when he wrote "almost."

**Zizánia aquática.** [*Zizanion* was the Greek name of some wild grain, *aquatica* = aquatic.] Wild Rice, Canada Rice, Indian Rice, Water Oats. Annually reproduces itself, six to ten feet in height, from under water in spring. Blades broad and green as small corn. Seed must be watched for as it falls daily in ripening.

# FINE *versus* COARSE AGROSTIS.

By James B. Olcott.

We have been told by botanists that Fine *Agrostis*, Dwarf Red-top, Fine Bent, Furze-top, Burden-grass, and R. I. Bent—all names for the same thing, perhaps—are not to be distinguished, structurally, from Tall Red-top or *Agrostis vulgaris.* This point of *structure* we leave to those who are regulating our botanic system.

But whoever is habitually using and recognizing these forms of Red-top, in farm and garden practice, will deny the identity of the varieties in question. Except that we are inveterate mixers of grass-seeds (though few of us care for grass, only to get enough of it), we should never think of classing them together in any farm catalogue. Because they are no more alike as used by wise farmers and gardeners, than a pony is like a cart-horse.

When seeding plow-lots for a crop or two of hay, we should feel cheated, if a seedsman were to sell us, inadvertently, the smaller, to mix with Timothy, instead of the larger variety of *Agrostis.* On the other hand, when tired of plowing a field, and wishing to seed it so it will run from a meadow into a permanent "butter pasture," perhaps, or a green home-lot, with a fine close sward at bottom, we take much pains to get seed of the smaller grass. Sod of the larger one never tempted spade to lift it, but turf of fine *Agrostis* is a beautiful possession.

Hence—for seeding door-yards, or lawns, where *Agrostis* is preferred, and the best effects desired, the dwarf ones are so much finer in their leaves, stems and roots, that the coarse varieties will never be used in nice gardening for any such permanent purpose. We don't put carpet wools into broadcloth. This is not a treatise upon lawn-making, but parenthetically it may be said here that seedsmen's mixtures, composed of all they recommend for lawns, seem best devised to render uniform, fine texture impossible. We have creeping *Agrostis*, both coarse and fine, in old and well established varieties, preferring, so far as we know, decidedly wet land or wet seasons, and suffering on dry land in dry seasons. The fine one is of value in lawn-making, but to sow it, mixed, on very dry places, would be unskillful, wasteful, contrary to nature, which fitted it to endure wet, and to art which must mind all these particulars to produce a perfect lawn from seed. When farmers learn to grow, dealers learn to sell, gardeners learn to use, and consumers learn to appreciate pure seed, the art of lawn-making and all grass growing will be established on firm foundations. Mixed seeds for the lawn are like mixed colors for the artist, fibers for the factory, and drugs for the chemist—only valuable for purposes to which they exactly apply.

*Agrostis*, moreover, means *a field*, or *of the field*. This shows the old botanists knew what they were about. Few, if any of this species, bear shade or the drip of trees very well. The place in the door-yard for the *Agrostis*, then, is in the open, trodden, sunny parts of the ground, and plenty of pure seed must be used, where the land is foul with weeds (as it should not be) to produce fair results. Since clean, fine seed is so scarce—at present, indeed, well nigh impossible to find—impure seed has its value for pastures and meadows.

With seed of one coarse *Agrostis* the market is better supplied than ever before in the world. It makes seed freely at the west, and our stock in trade is drawn by train loads from clean fresh lands within two hundred miles of St. Louis. Its pressure on the market is such that it threatens to become more common than the old "common" grazier's Red-top.

Both forms of *Agrostis* are common in Connecticut, and often found growing side by side, one nearly twice as high as the other. Where much plowing is done, the larger variety is apt to prevail. The seed of it, being cheaper, and making tall, coarse hay, is often the only *Agrostis* sown. Where farm animals are brought home nights, from good old pastures, long free from the plow, the seed of dwarf Red-top is frequently scattered widely by cattle, or farm manure, and only for special purposes needs to be bought.

There are thousands of acres of rough pasture sward in every county of the State, largely composed of this old English "Fine Bent." Sheep, if well managed, improve a dwarf *Agrostis* sod, while eating most other kinds of grass out. The connection between fine mutton and Fine Bent seed-growing is natural and practically absolute. Since flocks have disappeared, the fine grass has been overgrown by coarser ones, or with weeds and bushes. Formerly hundreds of bushels of fine *Agrostis* seed were saved from sheep pastures in this State. Now we learn of none being grown for market.

Rhode Island—as nearly as diligent inquiry last spring could determine—is the only source of genuine "Bent" in American trade. Scattering districts and islands, where sheep and painstaking family industries remain together, still produce a scant supply of this valuable seed; though, to say the least, it is sometimes none too clean; but for this fault there are plenty of excuses. From personal examination of the seed-producing districts, we have reason to believe that the product of pure seed—never very large—is now decreasing.

There are reasons for this which should be made public: *First*, botanists have not, generally, recognized the agricultural differences between coarse and fine *Agrostis*. *Second*, there were no positive safeguards against error, either in farm literature, history or tradition. Indeed, much of our literature is misleading. *Third*, buyers, in many cases, have not understood what they needed. *Fourth*, seedsmen, pressed by demand and pinched by supply, grew desperate or unscrupulous, when armed by botanic authority. *Fifth*, growers and land-owners, during the change or decline of eastern agriculture, became careless or helpless in this matter. These conditions, along with general laxity, indifference, pre-occupation and lack of accurate information in things graministic, combined, gradually to bring the much cheaper seed of coarse Red-top, mixed or unmixed, willfully or ignorantly, largely into use in place of the scarcer dwarf *Agrostis*. Many young farmers and gardeners do not recognize the latter, growing at their feet. Unless we have a change for the better in public comprehension, the production of Fine Bent seed for market is on its last legs.

Experiments in growing dwarf *Agrostis* at the far west, have not been successful. Timely rains, as well as close pasturage, and a good soil are required to produce a sod of fine *Agrostis* in several years time. It is a peculiarly wholesome and necessary industry, most in accordance with the genius and circumstances of the east, that is in danger of extinction.

The botanic situation was complicated, some ten or twelve years ago, by the well-meaning efforts of a Providence merchant—assisted by a botanist—to stem the tide of adulteration. This injured his own business and that of seed growers in the Narragansett country, who relied for a living on their sales of fine *Agrostis* seed under the trade name of Rhode Island Bent.

After what he considered a sufficient examination, this worthy botanist declared that the systematic name of R. I. Bent should be *Agrostis canina*, and this name was actually adopted in the lists of several eminent seedsmen.

In seed of R. I. Bent from the best farms, there possibly is, a small quantity—in one case, five to twenty-five per cent.—of still another variety of fine *Agrostis*. This has awns or beards, as wheat or barley is bearded or bald, but we found no seed grower already aware of the awns on his grass. Awned fine *Agrostis* may be *A. canina*, and may turn out to be better fitted, for some purposes, than bald Fine *Agrostis*. But there is not and probably never was enough of it to cover the legitimate seed crop of R. I. Bent with its name. And of course with growers ignorant of it, not enough to hold the market against the substitution, among people who don't mind what they are doing with grass, of the cheaper seed of coarse Red-top.

To stand the racket of trade, botanic distinctions that are vital must be *diffused* among growers, buyers and consumers at least, if not among the entire people, to do any good. This diffusion is the duty of the hour for those who know what botanic distinctions are vital to the lasting interests of honest and wholesome grass seed production and trade.

Leaving other seeds out of the account, there is reason to suppose that consumers of R. I. Bent are paying, on the average, $1 a pound for all the *bald* fine *Agrostis*, and $20 a pound for all the *awned* fine *Agrostis* they are getting. These prices may seem incredible, but considering the magnitude of our door-yard taxes and the sorry results we often secure in lawn-making, it is possible that if the seed were absolutely pure and in expert hands, even at those prices, it might really be cheaper than we are getting it now. Clean seed of the right variety may be spread very thin on *clean*, *rich* land!

Questions in systematic botany we purposely leave for settlement to those who are better qualified to judge than the writer. But the practical relation of fine to coarse *Agrostis* must ever, (let us hope,) be a matter of agricultural as well as botanic testimony. The large form seems to be the result of centuries of selection, seed saving and cultivation, for size of stem, foliage, and especially *for superior yields of seed*, by farmers and seedsmen who were constantly looking for the biggest things. In its seeding qualities this form of *Agrostis* is undergoing the same treatment, in the ripening climate of the far west that our small grains had undergone long before. The grass appears to have grown more seedy and strawy than the original or native type, as the small grains have undoubtedly so changed under the interested hand of man.

The two fine varieties of dwarf *Agrostis*, to which this memorandum is designed chiefly to call attention, we are venturing to believe, are two of the perpetual *peasant* forms of this species. Confident in their own enduring substance, under the best grazing conditions, they produce less seed and more leaves in proportion than forms do that have been long treated especially for seed. The best seed is grown in old pastures, during flush seasons for feed. Some years the seed is not worth harvesting, but the short, thick growth of fine, pointed, radical leaves—the pride of intelligent graziers and gardeners—never fails. One of the ancient farm names for this grass, (the awned form, perhaps,) is "burden grass," because—when mingled with white clover, in rich, moist, old meadow—of the fleece-like burden rolling from the scythe.

With regard to original or native forms of grazing grasses, it may be observed in passing, that characteristics analogous to what have just been mentioned, will be observed in the behavior of certain bunchy and strawy forms of the small fescues, from trade seed, as compared with their more leafy, spreading, and less woody or seedy congeners in old sward.

## COMPLIANCE WITH THE FERTILIZER LAW ON THE PART OF DEALERS.

DEALERS who have complied with the fertilizer law by furnishing the Director of the Station with the information required in the 4th section:

Alford, G. H., Winsted.
Apothecaries Hall Co., Waterbury.
Balch & Platt, West Winsted.
Barstow, J. P. & Co., Norwich.
Benton, C. E., Sharon.
Birdsey & Foster, Meriden.
Blakeslee, Jacob, Watertown.
Brainard, H. K., Thompsonville.
Brownell, E. C., Moodus.
Butler, John L., Torrington.
Bun, Fred. P. & Co., Middletown.
Carman, J. B., So. Coventry.
Chandler & Morse, Putnam.
Chamberlain, A. L. & Co., New Haven.
Chamberlin, Lewis, North Coventry.
Converse, R. S., Stafford Springs.
Cutler, J. W., Putnam.
Dakin, C. B. & Co., Sharon.
Dean, Jas. E., Winsted.
Dickerman, Elam J., Mount Carmel.
Dyen, M. S., Canton.
Eddy, Sam'l, Canaan.
Ellsworth, F., Hartford.
Emmons, S. H., Moodus.
Leonard, J. E., Jewett City.
Gifford, H. M., East Woodstock.
Godfrey, E. A., Westport.
Goodman, John, East Litchfield.
Grant, Geo. W., Wapping.
Greenwood Co., New Hartford.
Griffiths, Silas, Sterling.
Gillette, C. S., Cheshire.
Hall, Henry L., 2d, Wallingford.
Hall, L. A. & Co., So. Coventry.
Hall, S. J., Meriden.
Hopson, Geo., Kent.
Hubbard, A. A., Canaan.
Hull & Sweet, So. Coventry.
James, C. D., Danielsonville.
Jones, H. L., New Hartford.
Kingsbury, Andrew, Coventry.
Knight, F. M., Thompson.
Lewis, J. A., Willimantic.
Littlefield, Jno. E., Niantic.
Lincoln & Boss, Willimantic.
Martin Bros., Wallingford.
Martin, C. F., Elliott.
Martin, F. W., Chaplin.
Mansfield, D. B., Harwinton.
Merrow, J. B. & Sons, Merrow.
Morgan, Daniel, Poquonnock Bridge.
Peck Bros., Northfield.
Phelps, J. P. & L. C., Hamden
Platt & Merwin, Milford.
Pratt, C. M., Westbrook.
Roberts, A. F., Lakeville.
Russell, A. S. & Co., Meriden.
Sardam, Wm., Canaan Valley.
Smith, B. E., East Granby.
Smith, C. S., Kent.
Southington Lumber & Feed Co., Southington.
Still, Andrew J., Southport.
Stillman, H. A., Hartford.
Talcott & Alvord, Torrington.
Tucker, R. H., Saybrook.
Ure, Andrew, Hamden.
Walker & Nutting, Waterbury.
Warner, D. B. & Son, East Haddam.
Wilson, Allen, Suffield.
Wilson & Burr, Middletown.
Wilson, D. B. & Co., Waterbury.

The above should have had place on page 19 of this report, but was overlooked.

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## FERTILIZER SALES IN CONNECTICUT IN 1887.

In November last a circular was addressed to each manufacturer of fertilizers whose goods were legally sold in this state, asking for a statement of his total sales in Connecticut of the different classes of commercial fertilizers for the year ending

Nov. 1, 1887. This request was made with the promise that the statement should be regarded as strictly confidential, and that only the aggregage sales in the state by all manufacturers should be published. Twenty-nine firms complied with this request, one firm declined to comply and thirteen took no notice of the circular. The aggregate amounts reported by twenty-nine firms are as follows:

| | |
|---|---|
| Kainit, | 177 |
| Muriate of potash, | 183 |
| Sulphate of potash, | 30 |
| Sulphate of ammonia, | 40 |
| Nitrate of soda, | 69 |
| Blood, Ammonite and Fish, | 157 |
| Other nitrogenous matters, | 1,052 |
| Bone, | 1,331 |
| Plain superphosphate, | 195 |
| Ammoniated superphosphates without potash, | 53 |
| "Complete" manures, | 8,000 |
| Total, | 11,287 |

If the sales of the fourteen other firms were on the average as large, the total sales would be about 16,700 tons. We believe the total sales were above rather than below these figures. A moderate estimate of the cost to purchasers of this quantity of fertilizers is $500,000.

## THE COMPOSITION OF AMERICAN FEEDING STUFFS.

BY DR. E. H. JENKINS.

On subsequent pages is given in tabular form the average composition of the feeding stuffs commonly used in this country, compiled exclusively from American analyses. In the first column of these tables is stated the total number of analyses from which the average was obtained. The probable accuracy of the average increases with the number of analyses on which it is based.

As it is very desirable to know within what limits the composition of each fodder is likely to vary, the maximum and minimum amounts of each ingredient have also been inserted in the table.

## COMPOSITION OF AMERICAN FEEDING STUFFS.

| Name. | Analyses. | Total Dry Matter. | | | Albuminoids or Protein. | | | Crude Fat. | | | Nitrogen-free Extract. | | | Fiber. | | | Ash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | |
| GREEN FODDER. | | | | | | | | | | | | | | | | | |
| Maize Fodder | 48 | 7.1 | 30.9 | *19.02* | .6 | 3.0 | *1.63* | .1 | .9 | *.41* | 3.2 | 19.7 | *10.62* | 1.9 | 11.4 | *5.23* | 1.13 |
| Maize Fodder, ensilaged | 57 | 13.0 | 28.4 | *19.48* | .7 | 2.8 | *1.49* | .2 | 1.8 | *.68* | 5.1 | 18.3 | *10.26* | 3.0 | 10.0 | *5.68* | 1.31 |
| Sorghum | 7 | 13.6 | 28.4 | *21.66* | .9 | 1.4 | *1.10* | .2 | .5 | *.36* | 5.3 | 27.0 | *13.08* | 4.7 | 8.5 | *6.25* | .87 |
| Sorghum, ensilaged | 5 | 22.0 | 28.1 | *24.17* | .6 | .9 | *.75* | .1 | .4 | *.28* | 13.8 | 19.0 | *15.82* | 5.9 | 6.8 | *6.28* | 1.04 |
| Rye Fodder | 6 | 21.9 | 25.3 | *24.72* | 2.3 | 3.0 | *2.61* | .2 | .7 | *.56* | 4.9 | 12.4 | *6.94* | 4.9 | 14.9 | *12.73* | 1.88 |
| Rye Fodder, ensilaged | 1 | .... | .... | *19.25* | .... | .... | *2.42* | .... | .... | *.27* | .... | .... | *9.18* | .... | .... | *5.76* | 1.62 |
| Oat Fodder | 2 | 21.4 | 28.8 | *25.10* | 1.5 | 2.0 | *1.77* | .4 | .7 | *.57* | 10.8 | 14.6 | *12.70* | 7.1 | 9.5 | *8.27* | 1.79 |
| Clover | 1 | .... | .... | *26.67* | .... | .... | *4.09* | .... | .... | *.69* | .... | .... | *11.61* | .... | .... | *8.12* | 2.16 |
| Clover, ensilaged | 3 | 21.5 | 27.4 | *23.73* | 3.0 | 3.8 | *3.34* | .9 | 1.1 | *1.02* | 8.1 | 11.4 | *10.21* | 5.1 | 8.6 | *6.66* | 2.50 |
| Cow-pea vines, green and succulent | 2 | 14.0 | 17.9 | *15.93* | 3.0 | 3.3 | *3.12* | .6 | .6 | *.60* | 5.3 | 8.5 | *6.90* | 2.9 | 4.1 | *3.48* | 1.83 |
| Beet leaves | 1 | .... | .... | *11.16* | .... | .... | *2.74* | .... | .... | *.60* | .... | .... | *2.49* | .... | .... | *2.50* | 2.83 |
| Carrot leaves | 1 | .... | .... | *16.70* | .... | .... | *4.26* | .... | .... | *.86* | .... | .... | *5.99* | .... | .... | *2.25* | 3.34 |
| Cabbage ensilage | 1 | .... | .... | *12.39* | .... | .... | *1.19* | .... | .... | *.93* | .... | .... | *4.52* | .... | .... | *1.59* | 4.16 |
| HAY AND DRY COARSE FODDER. | | | | | | | | | | | | | | | | | |
| Clover hay | 33 | 78.2 | 93.9 | *88.63* | 8.9 | 20.8 | *12.55* | 1.5 | 4.3 | *2.44* | 35.0 | 49.0 | *40.55* | 15.6 | 35.7 | *26.86* | 6.23 |
| Hay containing much clover | 10 | 85.5 | 89.8 | *86.68* | 6.3 | 14.4 | *10.33* | 1.5 | 3.1 | *2.52* | 31.8 | 45.2 | *40.46* | 19.7 | 35.1 | *28.07* | 5.30 |
| White clover hay | 2 | 91.4 | 92.9 | *92.12* | 14.1 | 20.0 | *17.03* | 2.1 | 5.8 | *3.95* | 38.2 | 40.6 | *39.38* | 20.3 | 27.3 | *23.75* | 8.00 |
| Alsike clover hay | 4 | 91.6 | 94.8 | *92.63* | 11.4 | 16.1 | *13.50* | 1.6 | 4.2 | *2.35* | 36.5 | 43.5 | *40.86* | 27.7 | 29.5 | *28.61* | 7.31 |
| Lucerne hay | 3 | 92.5 | 94.4 | *93.52* | 15.0 | 18.6 | *17.04* | 1.8 | 2.4 | *2.05* | 35.5 | 39.2 | *37.12* | 26.2 | 33.0 | *30.21* | 7.10 |
| Timothy hay (*Phleum pratense*) | 53 | 84.5 | 92.9 | *89.76* | 4.2 | 9.6 | *6.06* | 1.0 | 3.4 | *2.12* | 39.2 | 58.5 | *47.10* | 22.7 | 38.5 | *30.37* | 4.11 |
| Red top hay (*Agrostis vulgaris*) | 1 | .... | .... | *90.16* | .... | .... | *7.25* | .... | .... | *1.95* | .... | .... | *46.52* | .... | .... | *27.45* | 6.99 |
| Timothy and Red top | 10 | 85.7 | 91.8 | *87.64* | 4.8 | 9.0 | *6.52* | 1.5 | 2.7 | *2.00* | 38.5 | 48.9 | *44.15* | 24.7 | 38.4 | *30.17* | 4.80 |
| Orchard grass hay (*Dactylis glomerata*) | 4 | 88.2 | 93.5 | *91.87* | 3.6 | 8.2 | *6.33* | 1.4 | 2.4 | *1.93* | 33.5 | 48.6 | *44.45* | 29.7 | 38.3 | *33.81* | 5.35 |
| Hungarian grass hay | 13 | 91.0 | 95.2 | *92.85* | 5.0 | 12.3 | *7.22* | 1.5 | 3.5 | *2.14* | 44.4 | 53.0 | *49.41* | 23.6 | 31.3 | *28.25* | 5.83 |
| Barley hay (seed in milk) | 1 | .... | .... | *89.75* | .... | .... | *9.21* | .... | .... | *2.47* | .... | .... | *47.49* | .... | .... | *26.14* | 4.44 |

## Composition of American Feeding Stuffs—*Continued.*

| Name. | Analyses. | Total Dry Matter. | | | Albuminoids or Protein. | | | Crude Fat. | | | Nitrogen-free Extract. | | | Fiber. | | | Ash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | |
| HAY.—*continued.* | | | | | | | | | | | | | | | | | |
| Oat hay | 3 | 86.3 | 91.3 | *89.32* | 7.8 | 9.9 | *8.53* | 2.1 | 3.1 | *2.52* | 36.2 | 48.0 | *41.93* | 25.1 | 33.6 | *29.92* | 6.42 |
| High meadow hay | 2 | 88.7 | 89.4 | *89.02* | 6.8 | 8.3 | *7.57* | 2.0 | 2.5 | *2.25* | 46.9 | 47.5 | *47.19* | 24.3 | 25.2 | *25.78* | 6.23 |
| Hay from mixed meadow grasses | 9 | 81.0 | 87.0 | *84.52* | 4.9 | 7.9 | *6.24* | 1.4 | 2.7 | *2.05* | 34.4 | 47.3 | *40.43* | 23.7 | 35.9 | *31.09* | 4.71 |
| Low meadow hay | 10 | 85.5 | 93.6 | *89.50* | 4.6 | 10.4 | *7.70* | .7 | 3.6 | *2.20* | 39.8 | 55.2 | *43.60* | 21.4 | 40.0 | *30.20* | 5.80 |
| Hay from salt marsh grasses | 13 | 81.4 | 92.8 | *89.89* | 4.0 | 7.8 | *5.69* | 1.6 | 3.1 | *2.31* | 34.1 | 54.3 | *44.10* | 25.1 | 37.9 | *30.51* | 7.28 |
| Baled hay, "extra fine" | 1 | .... | .... | *84.05* | .... | .... | *6.20* | .... | .... | *2.19* | .... | .... | *45.13* | .... | . | *26.60* | 3.93 |
| Maize fodder, field cured | 4 | 60.6 | 77.1 | *65.02* | 3.8 | 4.6 | *4.23* | .6 | 1.6 | *1.08* | 30.5 | 40.8 | *33.79* | 18.7 | 24.7 | *21.27* | 4.65 |
| Maize stover, field cured | 9 | 63.5 | 83.8 | *77.17* | 3.8 | 8.3 | *5.38* | 1.1 | 1.9 | *1.45* | 35.8 | 46.2 | *40.30* | 19.1 | 29.5 | *25.18* | 4.86 |
| Maize stover, dried | 11 | 87.0 | 92.4 | *90.43* | 3.4 | 8.5 | *5.02* | .8 | 1.5 | *1.10* | 45.3 | 52.9 | *49.17* | 26.6 | 33.6 | *29.92* | 5.23 |
| Buckwheat straw | 3 | 89.6 | 91.0 | *90.09* | 3.3 | 7.8 | *5.15* | .7 | 1.7 | *1.26* | 32.1 | 38.9 | *35.16* | 37.2 | 46.8 | *42.98* | 5.54 |
| Oat Straw | 12 | 87.5 | 93.5 | *91.26* | 2.3 | 6.9 | *3.82* | 1.0 | 3.2 | *2.22* | 26.4 | 51.4 | *38.89* | 29.5 | 56.0 | *41.52* | 4.81 |
| Rye straw | 8 | 87.5 | 93.7 | *92.24* | 2.2 | 6.9 | *3.46* | 1.0 | 2.7 | *1.40* | 35.7 | 52.9 | *38.35* | 34.2 | 43.3 | *45.25* | 3.78 |
| Wheat straw | 6 | 82.1 | 93.5 | *91.22* | 2.9 | 5.0 | *3.45* | .8 | 1.8 | *1.29* | 31.0 | 50.6 | *37.33* | 34.3 | 42.7 | *44.99* | 4.16 |
| Cow-pea vines | 6 | 86.0 | 90.7 | *85.95* | 13.6 | 19.8 | *15.68* | 1.1 | 4.1 | *2.87* | 34.9 | 46.4 | *42.17* | 17.2 | 23.7 | *19.80* | 8.41 |
| ROOTS, BULBS, TUBERS AND OTHER VEGETABLES AND FRUIT. | | | | | | | | | | | | | | | | | |
| Beets, red | 2 | 10.5 | 12.3 | *11.43* | 1.5 | 1.7 | *1.60* | .2 | .2 | *.18* | 7.2 | 7.6 | *7.40* | .6 | 1.7 | *.12* | 1.08 |
| Beets, sugar | 8 | 9.2 | 16.4 | *13.03* | 1.7 | 2.9 | *2.01* | .1 | .2 | *.10* | 5.7 | 12.0 | *9.15* | .7 | 1.1 | *.87* | .90 |
| Mangolds | 6 | 5.6 | 11.7 | *8.68* | 1.0 | 1.9 | *1.52* | .... | .5 | *.16* | 2.4 | 8.4 | *5.00* | .8 | 1.0 | *.84* | 1.16 |
| Ruta bagas | 1 | .... | .... | *12.92* | .... | .... | *1.15* | .... | .... | *.09* | .... | .... | *9.11* | .... | .... | *1.16* | 1.41 |
| Turnips | 2 | 7.6 | 8.2 | *7.92* | .8 | 1.3 | *1.02* | .1 | .2 | *.18* | 5.8 | 4.2 | *5.03* | .8 | 1.2 | *1.01* | .68 |
| Carrots | 6 | 8.9 | 13.5 | *11.70* | .9 | 2.0 | *1.16* | .2 | .7 | *.42* | 5.1 | 10.4 | *7.68* | 1.0 | 2.3 | *1.38* | 1.06 |
| Onions | 6 | 6.5 | 18.4 | *12.45* | .8 | 2.3 | *1.41* | .2 | .4 | *.26* | 3.8 | 14.1 | *9.53* | .6 | .8 | *.69* | .56 |
| Potatoes | 7 | 19.4 | 24.1 | *21.90* | 1.1 | 3.0 | *2.19* | .... | .2 | *.10* | 15.3 | 20.0 | *18.19* | .3 | .9 | *.54* | .88 |
| Sweet potatoes | 5 | 26.6 | 34.0 | *29.37* | .5 | 3.6 | *1.55* | .3 | .6 | *.38* | 18.0 | 29.7 | *25.09* | .6 | 2.5 | *1.36* | .99 |

## COMPOSITION OF AMERICAN FEEDING STUFFS—*Continued.*

| Name. | Analyses. | Total Dry Matter. | | | Albuminoids or Protein. | | | Crude Fat. | | | Nitrogen-free Extract. | | | Fibre. | | | Ash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | |
| ROOTS, BULBS, ETC.—*continued.* | | | | | | | | | | | | | | | | | |
| Cabbage | 2 | 6.5 | 10.2 | *8.28* | 1.8 | 2.0 | *1.95* | .2 | .5 | *.33* | 2.0 | 3.5 | *2.75* | 1.4 | 3.0 | *2.21* | 1.04 |
| Squash | 2 | 4.8 | 5.4 | *5.12* | .6 | .6 | *.66* | .2 | .3 | *.28* | 2.9 | 3.5 | *3.24* | .5 | .5 | *.54* | .40 |
| Pumpkin | 1 | .... | .... | *7.73* | .... | .... | *1.11* | .... | .... | *.16* | .... | .... | *4.34* | .... | .... | *1.49* | .63 |
| Apples | 5 | 15.9 | 22.7 | *18.22* | .2 | 1.2 | *.69* | .3 | .6 | *.41* | 12.6 | 20.0 | *15.31* | .9 | 2.9 | *1.49* | .32 |
| GRAIN AND OTHER SEEDS. | | | | | | | | | | | | | | | | | |
| Barley | 9 | 87.4 | 92.7 | *89.08* | 8.6 | 15.7 | *12.39* | 1.5 | 3.1 | *1.86* | 66.7 | 73.9 | *69.88* | 1.2 | 4.1 | *2.57* | 2.38 |
| Buckwheat | 8 | 85.1 | 89.1 | *87.40* | 8.6 | 11.1 | *10.00* | 2.2 | 2.4 | *2.25* | 62.6 | 65.4 | *64.50* | 7.8 | 9.4 | *8.70* | 2.00 |
| Oats (raised in Conn.) | 7 | 86.5 | 90.7 | *89.06* | 8.0 | 10.1 | *9.32* | 4.7 | 5.8 | *5.29* | 59.0 | 63.2 | *61.55* | 8.9 | 12.9 | *9.95* | 2.95 |
| Oats | 25 | 86.5 | 91.1 | *89.06* | 8.0 | 14.4 | *11.38* | 3.4 | 5.8 | *4.81* | 50.8 | 66.9 | *60.05* | 1.5 | 19.4 | *9.85* | 2.97 |
| Rye | 6 | 86.8 | 91.3 | *88.40* | 9.5 | 12.1 | *10.60* | 1.4 | 2.1 | *1.70* | 70.7 | 73.9 | *72.60* | 1.4 | 2.1 | *1.60* | 1.90 |
| Wheat, winter | 242 | 83.8 | 92.9 | *89.48* | 8.3 | 16.6 | *11.73* | 1.3 | 3.9 | *2.11* | 68.1 | 76.6 | *72.01* | .4 | 2.9 | *1.77* | 1.86 |
| " spring | 13 | 86.6 | 91.9 | *89.63* | 8.1 | 15.4 | *12.51* | 1.8 | 2.5 | *2.20* | 66.1 | 78.6 | *71.19* | 1.3 | 2.3 | *1.82* | 1.91 |
| " unclassified | 55 | 87.6 | 90.9 | *89.31* | 9.8 | 14.7 | *11.96* | 1.6 | 2.8 | *2.10* | 68.5 | 74.7 | *71.50* | 1.2 | 3.1 | *1.92* | 1.83 |
| " Average of all Analyses | 310 | 83.8 | 92.9 | *89.46* | 8.1 | 16.6 | *11.80* | 1.3 | 3.9 | *2.11* | 66.1 | 78.7 | *71.89* | .4 | 3.1 | *1.80* | 1.86 |
| Maize, dent | 80 | 85.9 | 93.7 | *89.91* | 7.5 | 12.1 | *10.33* | 3.8 | 6.9 | *5.10* | 66.2 | 75.7 | *70.66* | 1.2 | 4.8 | *2.28* | 1.54 |
| " flint | 70 | 80.4 | 93.4 | *88.93* | 7.0 | 13.7 | *10.57* | 3.4 | 7.1 | *4.96* | 65.0 | 74.6 | *70.31* | .7 | 2.9 | *1.65* | 1.44 |
| " sweet | 26 | 89.1 | 94.0 | *91.18* | 9.5 | 15.3 | *11.62* | 3.8 | 11.9 | *8.14* | 61.8 | 72.4 | *66.70* | 1.5 | 5.2 | *2.80* | 1.92 |
| " "Western Corn" | 3 | 79.3 | 83.6 | *80.90* | 7.8 | 8.6 | *8.30* | 3.6 | 3.9 | *3.70* | 64.9 | 68.2 | *66.00* | 1.7 | 1.8 | *1.75* | 1.20 |
| " Average of all Analyses | 192 | 79.3 | 94.0 | *89.49* | 7.0 | 15.3 | *10.55* | 3.4 | 11.9 | *5.45* | 61.8 | 75.7 | *69.85* | .7 | 5.2 | *2.09* | 1.54 |
| Sorghum Seed | 9 | 83.2 | 90.7 | *87.48* | 7.6 | 11.2 | *8.88* | 2.1 | 4.6 | *3.65* | 66.8 | 73.6 | *71.26* | 1.4 | 3.2 | *1.88* | 1.80 |
| Cotton Seed, hulls and kernels | 1 | .... | .... | *92.28* | .... | .... | *15.72* | .... | .... | *18.56* | .... | .... | *29.09* | .... | .... | *25.73* | 3.16 |
| Cow Pea | 5 | 79.2 | 89.9 | *85.21* | 19.3 | 23.0 | *20.77* | 1.3 | 1.6 | *1.43* | 48.1 | 61.9 | *55.75* | 3.3 | 5.0 | *4.06* | 3.20 |
| Soy Bean | 4 | 86.9 | 93.9 | *91.53* | 34.6 | 40.2 | *37.22* | 12.3 | 19.0 | *16.52* | 26.2 | 30.5 | *28.21* | 3.7 | 6.0 | *5.12* | 4.46 |

## COMPOSITION OF AMERICAN FEEDING STUFFS—*Continued.*

| Name. | Analyses. | Total Dry Matter. | | | Albuminoids or Protein. | | | Crude Fat. | | | Nitrogen-free Extract. | | | Fiber. | | | Ash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | |
| FLOUR AND MEAL. | | | | | | | | | | | | | | | | | |
| Barley Meal | 3 | 83.8 | 86.0 | *84.90* | 8.8 | 13.9 | *11.80* | .7 | 2.2 | *1.70* | ---- | ---- | *70.90* | ---- | ---- | *.10* | .50 |
| Buckwheat Flour | 4 | 82.4 | 87.2 | *85.46* | 4.2 | 8.1 | *6.89* | .7 | 1.8 | *1 44* | 71.1 | 79.4 | *75.79* | .2 | .5 | *.34* | 1.00 |
| Oat Meal | 6 | 91.1 | 93.8 | *92.15* | 12.9 | 16.2 | *14 66* | 6.1 | 8.8 | *7 06* | 66.6 | 68.9 | *67.57* | .6 | 1.2 | *.86* | 2.00 |
| Rye Flour | 4 | 86.4 | 87.7 | *86 90* | 6.0 | 7.1 | *6.65* | .8 | .9 | *.84* | 77.6 | 79.1 | *78.28* | .4 | .5 | *.41* | .72 |
| Wheat Flour, from Winter Wheat* | 1 | ---- | ---- | *87.04* | ---- | ---- | *8 56* | ---- | ---- | *1.19* | ---- | ---- | *76.59* | ---- | ---- | *.17* | .53 |
| " from Spring Wheat† | 6 | 86.5 | 89.7 | *87.68* | 8.6 | 14.1 | *10.68* | .6 | 2.0 | *1.11* | 68.3 | 78.1 | *75.00* | ---- | 1.2 | *.22* | .64 |
| " Unclassified | 21 | 86.4 | 88.8 | *87.52* | 9.7 | 13.3 | *11.25* | .8 | 1.9 | *1.16* | 69.5 | 76.9 | *74.33* | .1 | 1.0 | *.25* | .53 |
| " Average of all varieties | 25 | 86.4 | 89.7 | *87.44* | 8.6 | 14.1 | *11.28* | [illegible] | 2.0 | *1.20* | 68.3 | 78.1 | *74.13* | .0 | 1.2 | *.27* | .56 |
| Graham Flour | 3 | 86.3 | 87.9 | *86.90* | 11.3 | 12.4 | *11.70* | 1.5 | 1.9 | *1.70* | 69.8 | 70.0 | *69.80* | 1.8 | 2.1 | *1.90* | 1.80 |
| Maize Meal | 56 | 74.5 | 92.0 | *84.15* | 7.1 | 10.3 | *9.16* | 2.2 | 5.1 | *3.81* | 57.0 | 74.0 | *67.84* | .5 | 2.8 | *1.80* | 1.46 |
| Hominy | 2 | 86.4 | 86.6 | *86.50* | 8.1 | 8.4 | *8.25* | .4 | .5 | *.44* | 77.1 | 77.2 | *77.12* | .3 | .3 | *.32* | .38 |
| Sorghum Meal, mostly decorticated | 1 | ---- | ---- | *86.84* | ---- | ---- | *8.25* | ---- | ---- | *3.85* | ---- | ---- | *71.27* | ---- | ---- | *1.88* | 1.59 |
| Pea Meal | 2 | 87.0 | 91.2 | *89.54* | 19.1 | 21.4 | *10.23* | .9 | 1.5 | *1.19* | 50.2 | 52.0 | *51.09* | 11.1 | 17.7 | *14.33* | 2.64 |
| BY PRODUCTS AND REFUSE. | | | | | | | | | | | | | | | | | |
| Apple Pomace | 7 | 22.1 | 27.4 | *22.94* | 1.0 | 1.7 | *1.40* | .6 | 2.0 | *1.36* | 12.6 | 17.6 | *15.63* | 2.0 | 5.9 | *4.01* | .54 |
| Brewers' Grains, wet from brewery | 15 | 20.6 | 31.4 | *24.99* | 4.3 | 7.7 | *5.57* | .8 | 2.9 | *1.68* | 10.1 | 15.7 | *12.86* | 3.0 | 5.6 | *3.87* | 1.01 |
| " " "dried" | 3 | 88.1 | 93.8 | *91.81* | 19.2 | 20.2 | *19.89* | 4.2 | 6.5 | *5.56* | 46.1 | 56.8 | *51.75* | 10.2 | 11.6 | *11.01* | 3.58 |
| " " kiln-dried | 1 | ---- | ---- | *97.43* | ---- | ---- | *20.30* | ---- | ---- | *6.40* | ---- | ---- | *54.89* | ---- | ---- | *11.79* | 3.97 |
| " " from Silo | 3 | 26.1 | 33.2 | *30.18* | 5.8 | 7.1 | *6.64* | 1.8 | 2.5 | *2.11* | 13.6 | 16.8 | *15.58* | 3.9 | 5.4 | *4.64* | 1.21 |
| Brewers's Swill | 1 | ---- | ---- | *5.70* | ---- | ---- | *1.90* | ---- | ---- | *.80* | ---- | ---- | *2.00* | ---- | ---- | *.70* | .30 |
| Malt Sprouts | 3 | 88.0 | 92.7 | *89 72* | 21.0 | 25.9 | *22.95* | 1.1 | 2.9 | *1.79* | 45.4 | 50.3 | *48.60* | 9.3 | 11.9 | *10.72* | 5.67 |
| Cotton Seed Meal | 29 | 81.5 | 94.2 | *91.68* | 23.3 | 50.8 | *42.39* | 10.2 | 18.0 | *13.37* | 12 7 | 38.6 | *22.97* | 2.7 | 11.7 | *5.69* | 7.26 |

* The average of 18 analyses, most of them incomplete, is: Total dry matter, 89.63; Ash, 64; Albuminoids, 10.[illegible]2.

† The average of 16 analyses, most of them incomplete, is: Total dry matter, 88 55; Ash, 60; Albuminoids, 11.63.

## Composition of American Feeding Stuffs—*Continued.*

| Name. | Analyses. | Total Dry Matter. | | | Albuminoids or Protein. | | | Crude Fat. | | | Nitrogen-free Extract. | | | Fiber. | | | Ash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | Min. | Max. | Aver. | |
| By Products and Refuse—*continued.* | | | | | | | | | | | | | | | | | |
| Linseed Meal, Old Process | 12 | 87.4 | 93.9 | 90.97 | 27.7 | 38.2 | 32.33 | 5.1 | 11.6 | 8.24 | 30.8 | 41.9 | 35.22 | 7.1 | 13.3 | 9.31 | 5.87 |
| " New Process | 12 | 86.6 | 93.2 | 89.25 | 27.1 | 37.1 | 32.85 | 1.3 | 4.4 | 3.08 | 35.2 | 48.0 | 38.29 | 7.6 | 14.0 | 9.46 | 5.57 |
| " Oil not removed | 1 | .... | .... | 91.67 | .... | .... | 22.97 | .... | .... | 30.26 | .... | .... | 25.48 | .... | .... | 9.60 | 3.36 |
| Palm Nut Meal | 3 | 89.1 | 93.8 | 91.71 | 13.5 | 16.0 | 14.39 | 6.4 | 18.7 | 13.30 | 33.8 | 41.6 | 38.88 | 18.7 | 23.9 | 21.40 | 3.74 |
| Rye Bran | 6 | 86.3 | 91.8 | 88.51 | 11.5 | 16.8 | 15.28 | 1.8 | 4.9 | 2.46 | 59.8 | 67.6 | 63.66 | 2.5 | 4.1 | 3.52 | 3.59 |
| Wheat Bran | 63 | 84.2 | 91.8 | 87.72 | 7.5 | 16.9 | 15.07 | 1.5 | 5.9 | 3.78 | 50.0 | 67.6 | 54.26 | 2.4 | 17.8 | 8.71 | 5.70 |
| " Middlings | 27 | 84.0 | 91.5 | 88.00 | 10.1 | 19.2 | 15.17 | 1.3 | 12.7 | 4.01 | 53.0 | 70.9 | 60.99 | 2.1 | 5.9 | 4.57 | 3.26 |
| " Shorts | 8 | 84.5 | 89.0 | 87.26 | 11.1 | 16.1 | 13.83 | 2.5 | 5.3 | 4.14 | 53.3 | 67.0 | 57.59 | 5.8 | 10.5 | 7.45 | 4.25 |
| "Hominy Chops," "Hominy Feed," "Baltimore Meal," "White Meal" | 11 | 86.5 | 91.9 | 88.86 | 7.9 | 11.2 | 9.85 | 4.6 | 11.2 | 8.43 | 61.0 | 71.1 | 64.49 | 2.5 | 4.8 | 3.59 | 2.50 |
| Gluten Meal | 11 | 88.3 | 92.7 | 90.61 | 25.0 | 35.0 | 29.58 | 4.2 | 8.7 | 6.31 | 44.7 | 58.5 | 52.64 | .7 | 3.8 | 1.34 | .74 |
| Maize Cob | 13 | 85.6 | 92.8 | 90.67 | 1.2 | 3.7 | 2.50 | .1 | .9 | .45 | 45.3 | 66.4 | 55.99 | 28.2 | 38.2 | 30.36 | 1.33 |
| "Starch Feed," refuse from starch manufacture | 8 | 27.8 | 37.7 | 34.34 | 3.6 | 7.7 | 5.73 | 1.3 | 4.3 | 3.02 | 18.7 | 28.9 | 22.21 | 1.6 | 4.3 | 3.17 | .21 |
| "Sugar Feed," kiln-dried, refuse from glucose manufacture | 2 | 89.6 | 93.4 | 91.50 | 13.1 | 13.5 | 13.30 | 5.9 | 11.2 | 8.60 | 54.9 | 61.4 | 58.10 | 8.4 | 10.7 | 9.50 | 2.00 |
| Sorghum Bagasse | 4 | 11.3 | 16.6 | 14.50 | .6 | .7 | .65 | .... | .... | .... | .... | .... | 10.20 | 2.8 | 3.3 | 3.10 | .60 |

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